Registered at the G.P.O. for Transmission to Canada and Newfoundland by Magazine Post.

VOL. 36. Ser. A. Part 8. pp. 241-272. AUGUST, 1948.

THE REVIEW OF APPLIED ENTOMOLOGY.

SERIES A: AGRICULTURAL.

ISSUED BY THE COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

LONDON:
COMMONWEALTH INSTITUTE OF ENTOMOLOGY,
41, QUEEN'S GATE, S.W.7.

Price 4s. net.

Commonwealth Agricultural Bureaux.

Executive Council.

Lieutenant-Colonel J. G. ROBERTSON, *Chairman*, Canada.
Sir PATRICK LAIRD, C.B., F.R.S.E., *Vice-Chairman*, United Kingdom.
J. E. CUMMINS, Australia.
E. MARSDEN, C.M.G., C.B.E., M.C., D.Sc., F.R.S., New Zealand.
A. P. VAN DER POST, Union of South Africa.
J. W. DULANTY, C.B., C.B.E., High Commissioner, Eire.
R. S. MANI, Officiating Deputy High Commissioner, India.
The High Commissioner for Pakistan.
Colonel W. F. RENDELL, C.B.E., Newfoundland.
W. V. D. PIERIS, Ceylon.
A. V. HUBBARD, Southern Rhodesia.
J. G. HIBBERT, M.C., Colonies, Protectorates and Mandated Territories.
Sir HERBERT HOWARD (*Secretary*), 2, Queen Anne's Gate Buildings, London, S.W.1.

COMMONWEALTH INSTITUTE OF ENTOMOLOGY

Director and Editor.

W. J. HALL, M.C., D.Sc.

Assistant Director.

T. H. C. TAYLOR, D.Sc.

Assistant Editor.

H. S. BUSHELL, M.A.

Head Office—British Museum (Natural History), Cromwell Road, London, S.W.7.

Publication Office and Library—41, Queen's Gate, London, S.W.7.

[Rubtzov (I. A.).] **Рубцов (И. А.). On two Species of the Family Phasiidae (Diptera) parasitic on *Eurygaster integriceps* Put. (Hemiptera).** [*In Russian.*]—*Rev. Ent. URSS* **28** no. 3–4 pp. 85–100, 11 figs., 6 refs. Leningrad, 1947. (With a Summary in English.)

Observations were carried out in 1942 and 1943 in various localities at altitudes of some 2,600–6,200 ft. in western Tadzhikistan on the Tachinid parasites of *Eurygaster integriceps*, Put. They showed that *Alophora subcoleoptrata*, L., was the most important and widely distributed, *Helomyia* (*Anantha*) *lateralis*, Mg., occurred less frequently, and *Gymnosoma* sp. was rare, the total percentage parasitism being 10–15. In one district, the nymphs and adults were attacked by a Hymenopterous parasite, apparently a Braconid.

All stages of *A. subcoleoptrata* and *H. lateralis* are described, and it is stated that eggs of the latter dissected in different stages of development from the ovaries of the females, differed greatly from those described by Vasil'ev [*R.A.E.*, A **1** 449]. Based on these dissections, the numbers of eggs produced were 28–30 for *A. subcoleoptrata* and over 100 for *H. lateralis*. Both species had two generations a year. The adults of *A. subcoleoptrata* occurred at all the altitudes surveyed, chiefly in association with graminaceous plants and were present in fields of grain when the bugs migrated to them. Hibernation took place in the pupal stage in turf, the hosts being abandoned in most cases after they had migrated to their winter quarters, but many parasitised bugs apparently remained in the valleys, since adult flies were abundant there in early spring. As soon as the overwintered bugs descended to the valleys, they were attacked by the flies. In 1943, most of the parasite larvae in the bugs were ready to pupate about 10th May, and young flies were observed in the field at the end of the month, the peak of the flight occurring in June. The second generation developed in June in adult bugs of the new generation. In the mountains, the development of both host and parasite lasted 2–3 weeks longer than in the valleys, so that at altitudes of 4,000–5,250 ft. first-generation adults were common until the second half of July, and at 5,900 ft. they were present even at the beginning of August. The flies were most active in the morning and evening at temperatures of 20–24°C. [68–75·2°F.] and sheltered in grass during the day and at night. At 22–24°C. [71·6–75·2°F.] in the insectaries, most of the adults died in 2–3 days, but they survived for up to 20 days when flowers and sugar were provided. When exposed to a temperature of 27–28°C. [80·6–82·4°F.] in the sun, they died in less than a day. The pupal stage lasted 15–20 days at 20–22°C. [68–71·6°F.] in the shade.

H. lateralis hibernated as a young larva in the host. The larvae abandoned the bugs soon after they migrated to the valleys in spring, and pupated, the pupal stage lasting about a fortnight. In 1943, the adults appeared at the end of April and became most numerous in the first half of May. At altitudes of about 4,900–5,250 ft., the adults of the first generation appeared about mid-June and mass flight occurred in the first ten days of July. In the insectary at 18–22°C. [64·4–71·6°F.], in May–June, the pupal stage lasted 17–22 days. In the field, the flies occurred chiefly among graminaceous plants and were active only in the mornings and evenings.

[Rubtzov (I. A.).] **Рубцов (И. А.). On the State and Outlook of the Biological Control of Insects.** [*In Russian.*]—*Rev. Ent. URSS* **29** no. 1–2 pp. 1–11, 8 refs. Leningrad, 1947. (With a Summary in English.)

As biological control of insect pests by the method of collecting local parasites and predators for breeding in the laboratory and mass release in the same locality has not given good results in the Soviet Union, where it has so far been almost the only method employed, the author discusses other methods that can be adopted, largely from a consideration of the literature. Parasites can

(967) Wt. P3/1804 9/48 S.E.R. Ltd. Gp. 432 [A]

be introduced from other countries or regions, but in this case, the climate and other ecological conditions should be similar to those in the country of origin of the parasite.

Better use should be made in the Soviet Union of indigenous parasites and predators. These are not always co-extensive with their hosts, and gaps in their distribution should be filled by the introduction of colonies. Parasites for release should be collected from the edges of their distribution areas, because conditions there are always less favourable than in the centres and they are therefore biologically more hardy. A slight change in environment is known to have a stimulating effect on an organism. The effectiveness of parasites could be increased by the crossing of varieties and strains and selecting those that are most adaptable to changes in environment and most active in parasitising the host.

[Vasil'ev (I. V.).] **Васильев (И. В.).** ***Lathromeris bruchocida*, sp. n. (Hymenoptera, Trichogrammatidae)—a new Parasite of the Pea Weevil and its practical Importance.** [*In Russian.*]—*Rev. Ent. URSS* **29** no. 1–2 pp. 36–43, 7 figs. Leningrad, 1947. (With a Summary in English.)

Descriptions are given in Russian and English of the adults of both sexes of *Lathromeris bruchocida*, sp. n., a Trichogrammatid that was observed near Kursk (central Russia) in 1939 and later in the Ukraine and appears to be the most effective of the known parasites of *Bruchus pisorum*, L., on peas. A study of its bionomics in the Province of Kharkov in 1940–41 showed that it overwinters as a full-fed larva in the eggs of its host on fallen pea-pods, on pods in stacks, or on the ground. It was also bred from eggs of *B.* (*Bruchidius*) *unicolor*, Ol., on sainfoin (*Onobrychis* [*sativa*]), and in experiments, it overwintered in eggs of that species and of *B. obtectus*, Say, in addition to those of *B. pisorum*; in the field, it probably overwinters in the eggs of various Bruchids. No adults survived the winter.

There were three generations a year. Adults from overwintering larvae appeared at the same time as those of *B. pisorum*, when the peas were beginning to flower. In 1941, parasitised eggs were first found on 19th June, and by the beginning of July 65–70 per cent. of the eggs were parasitised on early and medium-early peas. Development of the parasite was completed in 14–16 days at the prevailing temperature (22–25°C. [71·6–77°F.]), and first-generation adults were on the wing in the first half of July. They were responsible for a second peak in parasitism, which reached 55 per cent. at the end of July on late peas. Adults of the second generation were present in the first half of August and gave rise to overwintering larvae. The maximum flight of the adults of the first and second generations usually occurred during periods of high temperatures (23–25°C. [73·4–77°F.]) and a low relative humidity (40–60 per cent.). In laboratory experiments in which females were enclosed with eggs of *B. pisorum* in tubes, they each oviposited in 18–20 during the two days for which most of them survived, and some reproduced parthenogenetically. Only one parasite was obtained per host egg, and complete development lasted 12–14 days at 22–23°C. and 56–57 per cent. relative humidity. The ratio of males to females among adults of *L. bruchocida* reared from parasitised eggs collected in the field was 7 : 12. Some protection from attack was afforded by the habit of the Bruchid of laying two and occasionally three eggs on top of one another. *L. bruchocida* has in the past been confused with *Trichogramma evanescens*, Westw., but the latter is not known to parasitise the eggs of beetles, with the exception of *Cassida nebulosa*, L., from the eggs of which, collected near Kursk in July 1939, the author reared a dark variety. In experiments, *L. bruchocida* readily parasitised the eggs of *B. obtectus*, Say, but not those of *Tychius* spp. or of *Cassida* or *Gastrophysa*.

In view of the inadequacy of the existing control measures against *B. pisorum* and the effectiveness of *L. bruchocida*, its use on a large scale is suggested. Mass breeding in the laboratory and subsequent liberation on infested peas is recommended, particularly in areas in which it does not occur but in which climatic and ecological conditions resemble those of the Ukraine. Its natural spread is restricted by the poor flying abilities of the adults and the fact that peas for transport are usually shelled. Its introduction into fresh areas could be effected by despatching parasitised eggs in late spring, keeping them at 5–6°C. [41–42·8°F.] until flowering time and then distributing them over the field. In experiments, *B. obtectus* proved a suitable laboratory host, since it is easy to rear and develops quickly.

HODSON (A. C.) & WEINMAN (C. J.). **Factors affecting Recovery from Diapause and Hatching of Eggs of the Forest Tent Caterpillar, *Malacosoma disstria* Hbn.**—*Tech. Bull. Minn. agric. Exp. Sta.* no. 170, 31 pp., 6 figs., 16 refs. [St. Paul, Minn.] 1945.

The following is largely the authors' summary. A study in Minnesota of the effect of temperature on the termination of the embryonic diapause in *Malacosoma disstria*, Hb. [*cf. R.A.E.*, A **31** 2] showed that the diapause lasts for about three months after embryonic development is completed. The hatching response after exposure to temperatures ranging from 25 to —5°C. [77 to 23°F.] suggested that the diapause could be broken only after conditioning at temperatures below 20–25°C. [68–77°F.] for a sufficient length of time and that optimum conditions prevailed near freezing point. A histological study of embryos undergoing similar treatment showed that the fore- and mid-guts were packed with yolk during the diapause and that nearly complete absorption of the yolk was necessary before hatching took place. When the histological changes associated with yolk absorption were compared with hatching data, it became evident that temperature had little effect on the diapause, but influenced the course of development after the diapause was broken. The differential hatching observed after exposure to both high and moderately low temperatures is believed to have been caused either by some injury from high temperatures or desiccation, or by a beneficial effect of low temperature during a critical period occurring when the early stages of yolk absorption were in progress.

A further study of post-diapause development showed that temperatures covering a range of 10–25°C. [50–77°F.] were nearly equally favourable for hatching, the optimum conditions being found in a saturated atmosphere at 15°C. [59°F.]. A significant decrease in percentage hatch occurred at 30°C. [86°F.], and no larvae emerged even after several months of incubation at 5°C. [41°F.]. Over the range of favourable temperatures, the best moisture conditions were found to lie between relative humidities of 70 and 100 per cent. Failure of the eggs to hatch in a dry atmosphere was the result of a change in the physical properties of the chorion as well as direct water loss through desiccation of the embryos.

The " spumaline ", a term proposed to designate the collateral secretion with which the eggs are covered, was found to be hygroscopic and able to absorb considerable moisture from atmospheres of high relative humidities. Its principal function seems to be to prevent a rapid desiccation of the eggs in dry air and to conserve moisture that has been absorbed.

In experiments on the effects of soaking in water, the temperature at which eggs were soaked was found to be more important than the period of submergence. Parasites were affected less adversely by soaking than were the embryos of *M. disstria*. Both embryos and parasites are apparently able to adjust themselves to a reduction in oxygen supply or to the accumulation of carbon dioxide. The spumaline on soaked eggs prolongs the effect of immersion after the eggs have been removed from the water.

The eggs of *M. disstria* are not very resistant to desiccation, for hatching was reduced considerably after eight days of drying over calcium chloride at 23–26°C. [73·4–78·8°F.], and none took place after 32 days of desiccation. The egg parasites were considerably more resistant to it. This experiment offered further evidence that the degree of hardness of the chorion is a determining factor in the escape of larvae from the egg.

Cawthron Institute, Nelson, New Zealand. Annual Report 1945–46.—39 pp., 5 pls. Nelson, N.Z. [1946.]

In the section of this report dealing with fruit research (pp. 15–20), it is stated that the parasites [*Ephialtes caudatus*, Ratz., *Mastrus carpocapsae*, Cushm., and *Cryptus sexannulatus*, Grav.] introduced from Canada [*R.A.E.*, A **34** 323, etc.] for liberation against the codling moth [*Cydia pomonella*, L.] were still not sufficiently established to exert control.

Other entomological investigations, some of which have already been noticed [**34** 210], are reported in two further sections (pp. 29–34). *Chrysomela* (*Chrysolina*) *hyperici*, Forst., had spread from the point in the Awatere Valley at which it was liberated for the control of St. John's wort [*Hypericum perforatum*] [*loc. cit.*] and had destroyed the weed over very marked areas ; secondary growth had appeared in some, but the beetles were expected to destroy it. They readily fed on tutsan [*H. androsaemum*] in captivity, and liberations were therefore to be made in areas infested with this plant. *Antholcus varinervis*, Spin., was still not established on piripiri [*Acaena*] in the field near Nelson [**32** 78] and in the North Island, though it continued to thrive in the insectary. The eggs and larvae are consumed by slugs feeding on the leaves of *Acaena*, and the larvae are also attacked by spiders, so that failure of the sawfly to become established may be due to them and possibly to birds. The seed weevil [*Apion ulicis*, Forst.] infested a high proportion of the pods of gorse [*Ulex europaeus*] and was established over considerable areas in some regions ; in view of its satisfactory establishment and rapid spread in both islands, liberations have practically ceased. Control of *Sirex noctilio*, F., on pine trees by *Rhyssa persuasoria*, L., was satisfactory ; the rearing and distribution of this parasite were continued and liberations made in new localities. *Apanteles glomeratus*, L., which parasitised the larvae of *Pieris rapae*, L., was distributed to further places during the year [*cf.* **34** 323]. The introduced parasites, *Angitia cerophaga*, Grav., and *Thyraeella collaris*, Grav., continued to give excellent control of *Plutella maculipennis*, Curt., on crucifers [*cf.* **34** 323], especially on the North Island, although isolated crops showed marked infestations. A dust of 1 per cent. DDT in talc applied early in February to cabbages so heavily infested by the moth as to appear beyond recovery gave excellent control and even the most severely damaged plants soon showed vigorous growth.

Investigations on the possible influence of insects on the deterioration of tussock-grassland showed that *Persectania composita*, Gn. (*ewingi*, Westw.), was the only species everywhere present in significant numbers [*cf.* **29** 334] ; outbreaks of this Noctuid occur periodically on pastures in Tasmania and it also attacks crops in lowland districts of Canterbury. *Halotydeus destructor*, Tucker, was found to be established on the North Island in the reclaimed Ahuriri Lagoon area at Napier, where it severely damaged spring vegetables. This mite is a serious pest of subterranean clover [*Trifolium subterraneum*] in the specialised climate of Western Australia [*cf.* **32** 261], but will probably not be of importance on this plant in New Zealand ; it is likely to injure vegetables growing on light soil, however.

Experiments on the control of *Tyrophagus longior*, Gerv., and *Tyrolichus casei*, Oudm., which attack cheese, were concluded [*cf.* **33** 130]. It was found that they could penetrate a covering of wax applied to the cheese and

that dust barriers were of no value owing to the high humidities prevailing in cheese stores. Ammonia and methyl bromide were effective fumigants, but the former was readily absorbed by the cheese, and the latter is expensive and less persistent than dichlorethyl ether, which is the most satisfactory material for this purpose. Dichlorethyl ether is more conveniently applied as a liquid than as a vapour, and its effects are then more lasting. It should be applied to the shelving of the curing room at the rate of 1 lb. per 1,000 cu. ft. room space; placing the cheeses on treated scale boards is equally effective.

Preliminary observations on the value of zinc chloride, chlorinated naphthalene, zinc naphthenate, pentachlorphenol and two proprietary preparations in protecting timber from attack by borers, showed that the water-soluble materials did not prevent oviposition by *Anobium* and that when they were used at low concentrations there was a tendency for larval tunnelling to be prolonged. The oil-soluble ones were highly toxic to the adults, but the larvae tunnelled for a period of over four weeks in timber completely penetrated by them. Oil-soluble preservatives applied by means of a brush at the rate of one coating for every $\frac{1}{4}$ inch of timber thickness gave satisfactory control of *Anobium* and *Kalotermes* (*Calotermes*) *brouni*, Frogg.

MILLER (L. W.). **Codling Moth Control Experiments.**—*Tasm. J. Agric.* **18** no. 4 pp. 194–197, 2 graphs. Hobart, 1947.

An account is given of experiments in Tasmania to compare DDT and benzene hexachloride with lead arsenate for the control of *Cydia pomonella*, L. In 1945–46, pear trees at Campania were given a calyx and two cover sprays, on 16th October, 9th November and 11th January, respectively, of 0·1 per cent. p,p′ DDT or 0·1 per cent. benzene hexachloride, both prepared from mayonnaise-type emulsion concentrates, or of 3 lb. lead arsenate (30 per cent. As_2O_5) per 100 gals. water. The resulting mean percentages of fruits infested were 1·2, 27·8 and 7·3, respectively, the differences between treatments being highly significant. The DDT residues on the picked fruit were 1·3–6 parts per million.

Since it was thought that the type of emulsion used might have been responsible for the poor results obtained with benzene hexachloride, a wettable powder containing 46 per cent. benzene hexachloride was substituted in 1946–47, when tests were carried out on apple at Glenorchy. The strength of the lead-arsenate spray was increased to 3·5 lb. per 100 gals., and the three forms of DDT used were the 20 per cent. emulsion, a 50 per cent. commercial "Colloidal" suspension that was melted before being added to the water [*cf. R.A.E.*, A **36** 179], and a 50 per cent. dispersible powder. A calyx and two cover sprays were applied on 5th November, 5th December and 18th January, respectively. The percentages of fruits infested were 16·3 for lead arsenate, 10·9 for lead arsenate with 2 quarts white-oil emulsion per 100 gals. in the cover sprays, 27·3 for 0·1 per cent. benzene hexachloride, 3, 5 and 5·1 for 0·1 per cent. DDT as the emulsion, suspension and powder, respectively, 9·1 and 10·7 for the emulsion when the second cover and the calyx spray were omitted, respectively, 8·3 and 9·2 when lead arsenate was substituted for DDT in the first cover and calyx spray, respectively, and 6 for three sprays of 0·05 per cent. DDT as the emulsion. Statistical analysis showed that highly significant differences occurred between benzene hexachloride, lead arsenate, lead arsenate with white oil, the half-strength DDT emulsion and the full-strength emulsion, in order of increasing effectiveness. The superiority of the full-strength emulsion over the split schedules and the incomplete schedules, and of these last two over lead arsenate alone, was highly significant. The emulsion was significantly superior to the other forms of DDT. Fluctuations in temperature and in the numbers of moths caught by baits are shown on a graph.

The pears sprayed in the first season showed no signs of infestation by red mites, but the apple trees used in the second were infested by *Bryobia praetiosa*, Koch, and *Paratetranychus pilosus*, C. & F.; the population of the latter increased towards the end of the season on the trees sprayed with DDT, but it was not of great magnitude. The Jassid, *Typhlocyba froggatti*, Baker, which was prevalent in the orchard was controlled by DDT.

KEMP (H. K.). **Codling Moth Control.**—*J. Dep. Agric. S. Aust.* **51** nos. 1, 4, 5 pp. 6–9, 184–186, 229–236, 238, 8 graphs. Adelaide, 1947.

In the first section of this paper, the author briefly reviews the results of the experiments described in the second and third sections on the value of DDT for the control of the codling moth [*Cydia pomonella*, L.] on apple and pear in several districts in South Australia, and states that, while DDT has proved far more effective than lead arsenate, it can be recommended for use only in the hotter and drier districts where lead arsenate has failed to give economic control, as risk of damage from increased infestation by *Bryobia praetiosa*, Koch, appears to be invariably associated with its use. In other districts, it should be used only experimentally, and in all districts steps should be taken to control increased mite infestation. Suggestions are made for the most effective use of a DDT schedule, and notes are given on the timing and concentration of lead-arsenate sprays.

The second and third sections contain accounts of tests on apple in 1945–46, in which the DDT sprays were prepared from pyrophyllite containing 10 per cent. p,p′ DDT, and on apple and pear in 1946–47, in which they were prepared from a 20 per cent. emulsion concentrate, a dispersible wax containing 50 per cent. DDT or a dispersible powder containing 50 per cent. DDT. In most cases the sprays were timed according to the standard schedule of 0·4 per cent. lead arsenate.

The following is based on the author's summary of the results. DDT at concentrations of 0·05 per cent. or more proved significantly superior to 0·4 per cent. lead arsenate for the control of *C. pomonella* on both apple and pear, and in large-scale trials on apple it reduced heavy infestation to commercially negligible proportions at little greater material cost than lead arsenate. Evaluation curves obtained by plotting the total percentages of fruits damaged against DDT concentrations were similar to those for lead arsenate in previous seasons and showed that, with heavy infestation in small plots, a concentration of 0·1 per cent. DDT is apparently the optimum, whereas with lower infestation or in large areas, 0·05 per cent. is adequate. In two apple orchards in which *C. pomonella* had for many years been practically uncontrolled despite spraying with lead arsenate and oil, excellent control was obtained in one season using 0·05 per cent. DDT on a commercial scale. Analysis of residues showed that DDT did not persist on the trees any longer than lead arsenate. There was no significant difference in the control given by the three DDT preparations in 1946–47; the 50 per cent. dispersible powder was the most convenient to use, while the dispersible wax was troublesome to melt and dilute, and 4 lb. sodium carbonate (washing soda) was required per 100 gals. to prevent precipitation in the vat.

The use of DDT on apple and pear was invariably followed by an increase in infestation by *Bryobia praetiosa* in warm districts, but the increase was not serious in cold districts; it was very great on the pears, and the resulting damage more than offset a large reduction in infestation by *C. pomonella* due to DDT. In preliminary trials on the control of *Bryobia* on heavily infested apple trees, the percentages by which the numbers of mites and eggs per 60 leaves were reduced after ten days (long enough to allow eggs to hatch) were 99·74, 99·3 and 98·82 for hexaethyl tetraphosphate at 1 : 600, 1 : 800 and 1 : 1,000, less than 93 for nicotine sulphate at equivalent dilutions, and 99·38,

98·61 and 97·55 for white-oil emulsion at 1 : 40, 1 : 60 and 1 : 80. Good results were also obtained when white oil (1 : 60) was applied at the first indication of *Bryobia* increase. There was no indication of increase of the woolly Aphid [*Eriosoma lanigerum*, Hsm.] on apple trees sprayed with DDT, and Aphid colonies were normally parasitised by *Aphelinus mali*, Hald.

Benzene hexachloride, which was tested against *C. pomonella* on apple in 1945–46, was ineffective at the concentrations used (up to 0·2 per cent. γ isomer). Zinc fluoarsenate (0·4 per cent.) was less effective on apple and pear than lead arsenate at the same concentration, and did not noticeably remedy zinc deficiency, but it usually scorched the leaves less than lead arsenate.

It is concluded that growers intending to use DDT for the control of *C. pomonella* should apply an oil spray during the preceding winter to reduce *Bryobia* populations to a minimum. During the growing season, a spray of white-oil emulsion (1 : 60) should be applied in early or mid-November, most conveniently with the second cover spray. DDT is not recommended for use against *C. pomonella* in districts in which lead arsenate affords satisfactory control, and it should be restricted to coloured varieties to which white oil can be safely applied at any time. It should not be used on pears in the Murray Settlements until a reliable means of controlling *Bryobia* has been found.

WASON (E. J.). **The Black Peach Aphid** (*Anuraphis persicae-niger*) **in the Murrumbidgee Irrigation Area.**—*Agric. Gaz. N.S.W.* **58** pt. 10 pp. 525–529, 4 figs., 3 refs. Sydney, 1947.

Anuraphis persicae-niger, Smith, which occurs in most of the peach-growing areas of New South Wales, is an important pest of canning peaches in the Murrumbidgee Irrigation Area. Apricots growing on peach stock have been infested over a number of years, and in the Young district, where the Aphid is also of economic importance, peaches, plums and nectarines are infested. Apterous Aphids are present on the roots throughout the year ; infestation of low-borne lateral growth begins in late March or early April and may be heavy as early as May or June [*cf. R.A.E.*, A **30** 280] but the main damage to the tops of the trees occurs in spring. With the arrival of hot weather, sometimes as early as November, the Aphids move back to the roots, and they are rarely found on the aerial parts of the tree from late December to early March. Apterous forms predominate at all times, but alatae appear during September and October and migrate to other stone-fruit trees, migration being especially noticeable in blocks of young trees ; the immature forms reach maturity in 10–12 days in spring and in up to 30 days in winter. The Aphids are fostered by *Iridomyrmex rufoniger*, Lowne, and some control is afforded by larvae and adults of *Coccinella repanda* var. *transversalis*, F., and *Leis conformis*, Boisd., larvae of the Syrphid, *Xanthogramma grandicorne*, Macq., and *Chrysopa* sp., and an unidentified Braconid of the genus *Aphidius*, which in some seasons parasitises almost all the Aphids on heavily infested trees in late spring. In general, there is a lag of 3–4 weeks in spring before these natural enemies become numerous.

Nursery stock should be treated before transplanting by freeing the roots from soil and fumigating with hydrocyanic acid gas or immersing the roots in, or spraying them with, nicotine sulphate and soft soap. Infested trees sprayed with dormant or semi-dormant oils, dinitro-ortho-cresol, tar distillate, nicotine sulphate [*cf.* **30** 280], or 1 lb. derris and 5 lb. soft soap in 50 gals. water usually become reinfested from the roots in 7–10 days. Recent trials have shown that sprays of 0·1 per cent. DDT give good control and prevent reinfestation for 8–12 weeks in spring [*cf.* **35** 219], and it is suggested that this spray should be applied to the lower half of infested trees in autumn, preferably after pruning, after which dormant sprays, applied in late July, will keep infestation low until late August. A second application of DDT

at that time will ensure freedom from Aphids in September and October, when most of the damage usually occurs.

Insect Pests.—*Agric. Gaz. N.S.W.* **58** pt. 10 pp. 530–534, 2 figs. Sydney, 1947.

This part of a series on insect pests in New South Wales [*cf. R.A.E.*, A **36** 108] contains notes on the bionomics and control of *Heliothis armigera*, Hb., the larvae of which were thought likely to cause serious damage to flax, which was being grown extensively in many parts of the State in 1947, and of *Dacus* (*Strumeta*) *ferrugineus tryoni*, Frogg., which was abundant in late fruits throughout the coastal area in the season of 1946–47 and also in some inland areas. The Mediterranean fruit fly [*Ceratitis capitata*, Wied.], which became rare in New South Wales more than ten years ago [*cf.* **28** 290], was not taken in a survey in 1946–47 and has not been observed since 1941 [*cf.* **30** 500]. Measures for the control of fruit-flies are compulsory in New South Wales [*cf.* **29** 54] and instructions are given for the application of foliage bait-sprays. Satisfactory results have been obtained in gardens with a bait-spray of 1 fl. oz. nicotine sulphate and 2 lb. sugar in 3 gals. water, which should be applied to the foliage every 2–3 days if infestation is severe. It does not kill all the flies that feed on it, but it causes them to fall to the ground, where they are killed by heat or predators.

Brimblecombe (A. R.). *Lyctus* (**Powder Post**) **Beetles in Queensland Timbers.** —*Qd agric. J.* **65** pt. 3 pp. 172–185, 11 figs. Brisbane, 1947.

In view of the increased use in Queensland of hardwood timbers susceptible to attack by *Lyctus*, an account is given of the bionomics of *L. brunneus*, Steph., which is the prevalent species. A smaller species, *L. discedens*, Blkb., which has similar habits, also occurs in northern Queensland. *L. brunneus* has up to two overlapping generations a year, the adults being most abundant in spring and summer, but infestation is liable to begin at any time in sapwood of appropriate pore size and starch content [*cf. R.A.E.*, A **23** 147, 727; **24** 372]. *L. discedens* can oviposit in smaller pores than can *L. brunneus*, so that starch content is the predominating factor in northern Queensland. High ring-barking of certain species of trees before felling effectively protects the timber from attack by reducing the starch content [**35** 247], and impregnation with boric acid protects veneers [**27** 510] and sawn timber [**31** 216]. Boards up to two inches thick immersed in a 2 per cent. solution for 2–4 hours at 205°F. and then for a further period until the temperature drops to about 150°F. are stated to be permanently immune. The construction of suitable vats is briefly described. Short-term protection of logs is afforded by spraying the ends and all exposed sapwood with creosote and then sealing them with crude vaseline [**31** 265]. Infested timber should be subjected to heat sterilisation for two hours at 130°F. and not less than 80 per cent. humidity [*cf.* **25** 669] or brushed or sprayed with creosote, 1 lb. paradichlorbenzene in 1 gal. kerosene, or equal parts of kerosene and turpentine [*cf.* **33** 84]. A list is appended of Queensland commercial timbers that are susceptible to *Lyctus* attack.

May (A. W. S.). **Larger Horned Citrus Bug Control with D.D.T.**—*Qd agric. J.* **65** pt. 3 pp. 186–187. Brisbane, 1947.

Recent experiments have shown that nymphs and adults of the Pentatomid, *Biprorulus bibax*, Bredd., which is a common pest of *Citrus*, particularly lemon and mandarin orange, in many districts of Queensland, can be effectively controlled by spraying with DDT [*cf. R.A.E.*, A **35** 245]. A spray containing 0·2 per cent. DDT, applied as a fine mist to most of the leaves and twigs at the rate of about one gallon per tree, kills all the mobile stages with which it comes into contact and leaves a residue that remains toxic for two weeks to migrating

adults or newly hatched nymphs. A 0·1 per cent. spray has good contact properties but less residual effect. The sprays can be applied at any time and will normally be required in spring, early summer and midsummer, when the bugs migrate to the orchard. They can be combined with other sprays used in routine pest and disease control measures. An application of lime-sulphur (1 : 35) in early summer against the Maori mite [*Phyllocoptruta oleivorus*, Ashm.] should be included in any spray programme [*cf.* **34** 127], but as DDT has been found to favour its development [*cf.* **34** 384], another application of lime-sulphur, or, if the temperature is too high, of wettable sulphur is recommended later in the summer.

CANNON (R. C.). **Protection of harvested Potatoes from Tuber Moth Attack.**—*Qd agric. J.* **65** pt. 4 pp. 242–244. Brisbane, 1947.

Potato tubers in the ground in Queensland can be protected from attack by *Gnorimoschema operculella*, Zell., by late hilling [*cf. R.A.E.*, A **33** 186], with late watering as an additional safeguard. During harvesting, the tubers should be picked up as soon as possible after digging and treated with dusts to destroy exposed larvae and prevent further infestation. Dusts of derris (0·5 per cent. rotenone), DDT (2 per cent. p,p′ isomer) and magnesite are all effective, and potatoes dusted with derris or magnesite were stored for 14 weeks in summer in northern Queensland with losses of only 0·5 and 2·5 per cent., respectively, while untreated controls were completely destroyed by the larvae. The tubers should be completely covered with the dust, about 8 lb. per ton being required; magnesite is less effective in damp weather [*cf.* **31** 325]. The dusts should either be mixed with the tubers in the course of bagging in the field or spread on the bench over which they are passed when grading is done in a shed.

PEMBERTON (C. E.). **A new Fruit Fly in Hawaii.**—*Hawaii. Plant. Rec.* **50** no. 2 pp. 53–55, 1 fig. Honolulu, 1946.

Adults of *Dacus ferrugineus* var. *dorsalis*, Hend., were reared from mangos collected in Honolulu in early May 1946, and since this fruit-fly had not previously been recorded from the Territory, a survey was begun later in the month to determine its distribution there. It was found that it was well established in many widely separated areas on the Island of Hawaii and that it had been bred there, though not recognised, from fruits of *Psidium* sp. collected on 18th November 1945, from ripe bananas collected in March 1946 and from fruits of *Eugenia malaccensis*. It was also present in two districts on Maui and in many parts of Oahu, and was common in Honolulu. Other fruits infested by it in Hawaii were grapefruit and *E. jambos*. The world distribution of this fruit-fly is given, and the 24 principal fruits that it is known to attack are listed. It was probably introduced into Hawaii on infested fruit brought by air from Saipan.

PEMBERTON (C. E.). **Resistance to Termite Attack by Wood treated with Copper Naphthenate.**—*Hawaii. Plant. Rec.* **50** no. 2 p. 57, 1 pl. Honolulu, 1946.

Two pieces of pine wood completely impregnated with copper naphthenate that were received on 24th December 1940 were buried horizontally 4 ins. below the surface of the soil at a place on Oahu where *Coptotermes formosanus*, Shir., was abundant and damaging a building. When examined towards the end of March 1946, the wood was found to be practically undamaged by the termites, which were still numerous in the vicinity and were using the surface of one of the pieces as a runway, or by dry rot or other decay, although the soil was generally moist or wet. An odour resembling that of petrol, which was noticeable when the timber was buried, appeared to be intensified. The only damage

noted in the timber comprised a few small holes extending for a fraction of an inch into the wood and some slight surface scratches. Untreated wood buried at the same place was extensively damaged.

RISBEC (J.). **Note sur deux Cérambycides nuisibles des colonies françaises.**—*Agron. trop.* **1** no. 9–10 pp. 504–509, 5 figs., 5 refs. Nogent-sur-Marne, 1946.

Avenues are planted with *Khaya senegalensis* in M'Bambey, Senegal, and several well-sized trees in them have died in recent years. One such tree examined in June 1946 was found to have been killed by larvae of *Cordylomera nitidipennis*, Serv., of which the adult is described. The eggs of this Cerambycid are laid in groups of about 30, tightly packed in fissures in the bark. The young larvae enter the wood, gnawing first the sapwood and later, when nearly full-grown, the heartwood, in which they pupate in an axial chamber ; it is thought that their development probably lasts several years. The destruction of infested branches is probably the only means of control, since the larvae are inaccessible and no entrance holes are visible.

Larvae of the Lamiid, *Ptychodes trilineatus*, Serv., subsp. *insularis*, Fairm., the adult of which is described, bore in fig trees in Tahiti. This subspecies is merely a geographical form of *P. trilineatus* and information on the distribution, bionomics and control of the latter is quoted from a paper by J. R. Horton [*R.A.E.*, A **6** 101].

MASSIBOT (J. A.). **Note sur l'importance des dégâts causés dans le nord du Sénégal aux gousses d'arachides en cours de développement par** *Microtermes parvulus*.—*Agron. trop.* **1** no. 9–10 pp. 517–518. Nogent-sur-Marne, 1946.

The pods of ground-nuts [*Arachis hypogaea*] in Senegal are damaged during periods of drought in late winter by *Microcerotermes* (*Microtermes*) *parvulus*, Sjöst. It enters the growing pod through a slit made near the free end and pierces the terminal seed ; the sap escapes, and the seed fails to develop. In some cases, both seeds are attacked. The damage is more serious in northern Senegal, where the winters are shorter and drier. In normal seasons, 4–5 per cent. of the pods are attacked where the mean annual rainfall exceeds 18 ins., whereas in the Louga area, where the annual rainfall is often less than 12 ins., damage to 10 per cent. of the pods is common. In December 1941, at the end of a very dry period, 45 per cent. by volume or 30 per cent. by weight of a crop of ground-nuts in Louga was attacked, and 11 per cent. of the healthy pods and 33·5 per cent. of the damaged ones contained shrivelled, immature or stunted seeds. In 1937, after a normal winter, 11·5 per cent. by weight of the pods were attacked, and it was observed that the weight of damaged pods was only 67·9 per cent. of that of healthy ones, making an average loss in yield of 3·7 per cent. of the total production. On opening the pods it was found that 12·8 per cent. of seeds from undamaged pods and 52·8 per cent. of those from damaged ones were shrivelled or immature. These results show that termite damage to ground-nuts is far from negligible even in normal years, and may be serious in dry seasons.

ANANDA RAU (S.). **Report of the Entomologist (1945–46).**—*Rep. Tea sci. Sect. U.P.A.S.I. 1945–46* pp. 5–6. Madras, 1946.

In preliminary small-scale laboratory and field trials against *Helopeltis* on tea in south Travancore, a DDT dust believed to contain 3 per cent. active ingredient and a dust of 5 per cent. crude benzene hexachloride in chalk or sulphur proved highly toxic to both nymphs and adults ; although neither took immediate effect, benzene hexachloride acted more quickly than DDT. There was considerable reduction of feeding on dusted leaves ; in the case of DDT practically

no feeding occurred and all insects introduced died within 18 hours. In the field, dusted bushes from which all attacked shoots had been removed before treatment remained free of fresh punctures for three days in the case of DDT, but fresh ones were observed one day after treatment with benzene hexachloride. Damage to tea by *Helopeltis* was severe in south Travancore in 1945, and thrips [*Dendrothrips bispinosus*, Bagn.] continued to attack it in the Nilgiris [*cf. R.A.E.*, A **32** 433 ; **33** 246]. No adults emerged from soil samples taken from beneath infested bushes, so that the thrips probably pupate on the plant. The purple mite [*Eriophyes carinatus*, Green] was again reported from the High Range, where tea on one estate suffered considerable damage. DDT proved highly toxic to the tea Aphis [*Toxoptera aurantii*, Boy.] in a few laboratory tests.

In Nilgiri-Wynaad, a severe outbreak of *Helopeltis theivora*, Waterh., caused the abandonment of a nursery of red gum [*Eucalyptus rostrata*]. The Mirid was long known to be present in the district, but had not previously caused serious damage.

GADD (C. H.). **Studies of Shot-hole Borer of Tea. 1. Distribution and Nomenclature.**—*Tea Quart.* **18** pt. 2 pp. 46–54, 35 refs. Talawakelle, 1946.

Xyleborus fornicatus, Eichh., has been recorded as injuring tea in Ceylon since 1892 and was proclaimed a pest in 1912. Since its local distribution on tea there has not altered for many years and the risk of its spread as a pest to other parts of the island appears to be negligible, the author considers that the regulations restricting the movement of tea plants from any area, whether infested or not, should be rescinded. *X. fornicatus* has also been recorded from South India, northern Formosa and the Netherlands Indies on tea and from the Netherlands Indies on *Hevea*, but appears to be of importance only in Ceylon. Numerous plants are listed on which the Scolytid has been recorded in Ceylon and other eastern countries ; it probably does not breed in most of them.

The identity of the typical *X. fornicatus* and its subspecies, *X. fornicatus fornicatior*, Egg., is discussed [*cf. R.A.E.*, A **10** 572 ; **11** 257 ; **29** 381 ; **30** 319 ; **31** 160]. Examination of females from tea, castor (*Ricinus communis*) and *Mimosa bracaatinga* in Ceylon showed that the large type (typical *X. fornicatus*) predominated in castor and the small one (*X.f. fornicatior*) in *Mimosa* and one sample of tea, but that the large type was present also in tea and that intermediate sizes existed. Although in Ceylon beetles from castor will attack tea and those from tea will attack castor, the author has recently observed that the males in castor behave quite differently from those in tea, and he considers that biological differences probably exist, so that there may be some justification for retaining the two subspecific names. Since, however, the name *X.f. fornicatior* should be used only for the smaller race with the more arched back, it cannot apply to all the beetles from tea, of which a small number are typically *X. fornicatus* or *X.f. fornicatior* and the majority indeterminate, and the author proposes to use the name *X. fornicatus* ex-tea for them.

VUKASOVIĆ (P.). **Contribution à l'étude de la pyrale du maïs** (*Pyrausta nubilalis* **Hb.). Étude de l'insecte au laboratoire.** [*In Serbian.*]—*Arh. poljoprivr. Nauke Tehn.* **2** no. 2 pp. 40–71, 5 figs., 14 refs. Belgrade, 1947. (With a Summary in French.)

An account is given of a laboratory study in Belgrade on the effects of relative humidity and fertilisation on the fecundity of females of *Pyrausta nubilalis*, Hb. The genitalia of females less than 24 hours old and of older females that had or had not oviposited are described in detail, with notes on the way in which the adipose tissue is used up in the course of life. In the

experiments, unfertilised females were kept at relative humidities of 0 and 86 per cent. and temperatures of 25–26 and 23·5°C. [77–78·8 and 74·3°F.], respectively, and fertilised and unfertilised individuals at 100 per cent. humidity and 24°C. [75·2°F.]. The numbers of eggs laid were counted daily, and when the moths died, they were dissected and the condition of the ovaries examined.

The 12 unfertilised females kept under dry conditions lived for 1·5–2·5 days, did not oviposit and contained 0–126 eggs, with an average of 50 per female. The 16 kept at 86 per cent. humidity lived for 4–6 days and five oviposited, laying 1–9 eggs, with an average of 5 per female, which, together with those found in ovaries, gave an average total of 77 per female. The moths that did not oviposit contained 3–155 eggs, with an average of 62. Of the 35 unfertilised females kept at 100 per cent. humidity, 19 oviposited; these lived for 9–26 days, with an average of 14·5, and laid 1–189 eggs, with an average of 66, with the exception of one that laid 642 eggs which brought the average to 96. Including the eggs found in the ovaries, the total egg-production was 222–744, with an average of 462 per female. The moths that did not oviposit lived for 6–21 days, with an average of 12·5, and contained 64–800 eggs, with an average of 311. The 11 fertilised females lived for 7–22 days, with an average of 13, and laid 424–1,069 eggs, with an average of 684, which, together with the eggs found in the moths after dissection, gave an average total of 730 eggs per female. Thus, although high relative humidity increased fecundity and length of life, the main factor that induced oviposition was fertilisation.

Data from the literature on the fecundity of *P. nubilalis* are reviewed, and it is pointed out that they chiefly refer to the number of eggs deposited, without taking into consideration those remaining in the ovaries. The true fecundity is, therefore, much higher than has been thought and is a stable characteristic of the species, though dependent on the condition and functioning of the ovaries. The extent to which it results in oviposition depends on the external environment, and no females deposited all the eggs they contained.

The numbers of eggs laid at a time were recorded for the moths kept at 100 per cent. humidity. The unfertilised females laid almost half their eggs singly and 92 per cent. singly or in groups of 2–10, but a few batches contained 23–84 eggs. The fertilised moths laid only 3 per cent. of their eggs singly and the rest in batches of 2–176, mostly of 21–30.

In further detailed observations at 21 27°C. [69·8–80·6°F.] on the effect of atmospheric humidity on survival, the average length of life was 2 days for females and under 2 days for males kept at 0 per cent. relative humidity, 3·3 days for males and 5·3 for females that emerged at the end of June and 4·5 and 4·6 days, respectively, for those that emerged after 3rd July and were kept at an average of 86 per cent., and 5·5, 10·4 and 12·7 days for males that emerged before 3rd July, between 3rd and 8th July, and after 8th July, respectively, and 6·8, 10·8–15·3 and 13·6 days for females that emerged at the same times, all of which were kept at 100 per cent. relative humidity.

FENAROLI (A.). **Solfocianderivati applicati al campo entomologico. Nota I: esteri ciclici dell'acido solfocianacetico.** [Thiocyanic Derivatives for entomological Use. Note I: Cyclic Esters of Thiocyanoacetic Acid.]—*Boll. Zool. agr. Bachic.* **13** fasc. 1, 39 pp., 4 graphs, 24 refs. Milan, 1945.

The author reviews the literature on the use of thiocyanates as insecticides [*cf. R.A.E.*, A **20** 294; **22** 697; **23** 463; **25** 233] and describes field and laboratory experiments carried out in northern Italy in 1944 on the control of household and agricultural pests, using chiefly the thiocyanoacetic esters of cyclohexanol and amyl alcohol [*cf.* also B **36** 131]. Preliminary tests designed

to assess the action of these compounds as fumigants and stomach poisons gave inconclusive results, but garden spiders of two species that crawled over a thin layer of dusts impregnated with them died within a few minutes. Both esters were tested as 10 per cent. dusts adsorbed on bentonite against *Trichophaga* (*Tinea*) *tapetzella*, L., and *Tinea pellionella*, L. Small pieces of wool and fur heavily infested with larvae, pupae and adults of these species were dusted with the materials and kept in paper bags or in the open. After 10 minutes, all the insects present were dead, but some adults had flown away from the unenclosed samples. All the adults and larvae in controls survived. When uninfested pieces of wool were dusted and placed in boxes containing numerous adults of both species, all the latter were dead an hour later, although those in the controls survived. There was little difference in effectiveness between the materials, but the cyclohexanol ester had a more agreeable odour.

When several colonies of domestic ants of an undetermined species were dusted with the materials, most of the ants died within 10 minutes, but alate forms survived for twice as long. The powder was then laid down on the sills of windows through which the ants were in the habit of entering the house ; it formed an effective barrier, as the ants that tried to cross it were killed and others turned back as soon as they touched the insecticide. When the dusts were applied at the entrances of nests, ants attempting to leave fell back and brought the insecticide into the galleries. In two nests examined an hour after treatment, one with each substance, 70 per cent. of the ants were motionless and apparently dead, and in two others examined two hours after treatment all were dead. The amyl-alcohol compound acted slightly more rapidly than the other.

In laboratory experiments with Arthropods of agricultural importance, in addition to the thiocyanoacetic esters of amyl alcohol and cyclohexanol, those of phenol and β-naphthol were tested, all as 10 per cent. dusts on bentonite. When copiously dusted with the four substances, in that order, groups of 13–18 third-instar larvae of *Arge ochropa*, Gmel. (*rosae*, auct.), and 12 second-instar larvae of *Mamestra* (*Barathra*) *brassicae*, L., all died in 35, 35, 40 and 120 minutes, and in 3¼, 3½, 4 and 4½ hours, respectively. Groups of 80–107 nymphs and adults of *Aphis pomi*, Deg., on leaves of apple, were all killed in 23, 11 and 20 minutes, respectively, by the first three esters, but the β-napthol ester gave only 30 per cent. mortality in 4½ hours ; the mortality percentages among groups of 20 mature and immature examples of *Tetranychus telarius*, L., on apple leaves, given by the four insecticides were more than 75 in 45 minutes, 70 in 45 minutes, 75 in 15 minutes and 20 in four hours, respectively. The young mites were more resistant than the adults, and the survivors successfully completed their development. The mortality of the mite on peach leaves was considerably higher, but complete figures are not given. All but the β-naphthol compound were very toxic to an unidentified Aphid from lilies.

Tests with the four dusts on the foliage of apple, pear, peach, fig, grape and lily showed that all caused a certain amount of scorching, and although this was the most severe in the case of the amyl alcohol and cyclohexanol compounds, the greater toxicity of these would allow of a reduction in the concentration. Further experiments with dusts of these two esters on young shoots of vine, peach and fig showed that they were practically harmless at concentrations of 6 and 4 per cent., respectively, and small-scale field tests were accordingly undertaken using 2, 3 and 4 per cent. dusts of both insecticides against larvae of *Arge ochropa* on rose, *M. brassicae* on cabbage, and *Caliroa limacina*, Retz., on pear. The 4 per cent. amyl-alcohol dust gave complete mortality in 1, 5½ and 1 hour, respectively, and the 4 per cent. cyclohexanol dust in 1, 5 and 1¼ hours. The 2 and 3 per cent. dusts were considerably slower in action and did not always give a total kill. In field tests against Aphids, the amyl-alcohol and cyclohexanol esters were emulsified at

0·5 per cent. with 2 per cent. neutral sulphonated oil, giving stable homogeneous emulsions with an almost neutral reaction, and gave complete mortality of *Macrosiphum rosae*, L., on rose in 15 and 25 minutes, of *Aphis fabae*, Scop. (*rumicis*, auct.) on beans [*Phaseolus*] in 15 and 20 minutes, and of *Brevicoryne* (*Aphis*) *brassicae*, L., on cabbage in 10 and 25 minutes, respectively.

The methods of preparing the β-naphthol, phenol and cyclohexanol esters are described.

Surányi (P.). **The American " Fall Web-worm " in Hungary.** [*In Magyar.*] —*Agrártudományi Szemle* **1** no. 3 pp. 226–238, 3 pls. (2 col.), 23 refs. Budapest, 1947. (With a Summary in English.)

The following is based on the author's summary. A species of *Hyphantria* now considered to be *H. cunea*, Dru., was accidentally introduced into Hungary before 1940. It spread slowly to the south of Budapest until 1946, but by the autumn of that year had covered a semicircle of territory with a radius of over 30 miles. Until that year it was thought to be *H. textor*, Harr., as all the moths were white, with at most a few black spots on the upper part of the wings of the males, but in the spring of 1947, a considerable proportion of both sexes showed markings typical of *H. cunea*.

The moth had two generations a year, and larvae were observed feeding on the foliage of plants belonging to 21 genera, chiefly *Acer negundo*, mulberry and cherry. Poplars and willows were not infested, though they are in the United States. The caterpillars did not leave the nests to feed at night, as in the United States, but spun the leaves on which they fed into their webs. When they became two-thirds grown, they abandoned the nests, crawled about on the plants and moulted in the open. This change in habit is attributed to the absence of natural enemies.

Dąbrowski (Z.). **Stonka ziemniaczana.** [Potato Beetle.]—8 pp., 5 figs. [Warsaw] Minist. Roln. Reform roln. [1946.]

A short account is given of the spread of *Leptinotarsa decemlineata*, Say, on potato in Europe and it is stated that in 1946 it reached the Oder in small isolated foci and appeared in two localities in the Department of Poznań, on the Polish side of the frontier. The bionomics of the beetle are described, and a plan is outlined for the organisation of official inspections of potato crops.

Strawiński (K.). **Contribution to the Biology and Occurrence of *Neurotoma nemoralis* L. (Hymenoptera-Pamphiliidae) in Poland.** [*In Polish.*]—*Ann. Univ. M. Curie-Skłodowska* (C) **2** no. 4 pp. 121–129, 2 pls., 8 refs. Lublin, 1947. (With a Summary in English.)

An outbreak of the sawfly, *Neurotoma nemoralis*, L., occurred on cherries and plums near Godz (central Poland) in 1939. Large numbers of adults were observed at the beginning of May, and eggs were abundant, as many as 250 occurring in a leaf; since females did not lay more than 60 eggs each in the laboratory, it is thought that several must have oviposited in each leaf. The egg and larval stages lasted 10 and 30–40 days, respectively, in the laboratory, and the eggs hatched in 1–2 weeks in the field, first on cherries and a week later on plums. The eggs and larvae are described. The larvae feed gregariously on the leaves, which they web together. Feeding lasted a comparatively short time, but owing to the voracity of the larvae and their great numbers, the trees were defoliated. The larvae were particularly active in the second half of May and beginning of June, but all had left the trees by mid-June and entered the soil, where they overwintered. They were commonest at a depth of 10 ins. in sandy soil, but did not descend below 8 ins. in compact

soil. They moved towards the surface in spring (probably in March or April), and pupated in April at a depth of 3 ins. The pupal stage lasted about two weeks.

It is thought that this sawfly is present in Poland wherever stone-fruit trees are grown, and records of its occurrence there since 1908, chiefly on cherries and plums, are summarised in a table. Insectivorous birds are an important factor in checking outbreaks, and the larvae are parasitised by the Ichneumonids, *Holocremnus incrassator*, Hlmgr., and *Eulimneria* (*Limnerium*) *crassifemur*, Thoms. [*cf. R.A.E.*, A **12** 38].

Brown (N. R.). **Studies on Parasites of the Spruce Budworm,** *Archips fumiferana* **(Clem.). 2. Life History of** *Glypta fumiferanae* **(Viereck) (Hymenoptera, Ichneumonidae).**—*Canad. Ent.* **78** no. 7–8 pp. 138–147, 15 figs., 7 refs. Guelph, Ont., 1947.

In this second part of a paper on parasites of *Harmologa* (*Archips*) *fumiferana*, Clem., in eastern Canada [*cf. R.A.E.*, A **36** 239], descriptions are given of all stages of *Glypta fumiferanae*, Vier., together with notes on its bionomics based largely on observations in Ontario, when it was reared from the budworm on balsam fir [*Abies balsamea*] and spruce. It overwinters, either as an egg or as a very young larva, in the hibernating host larva, and develops in spring in the feeding host. It emerges as a full-fed larva when the host is in the fifth or sixth instar, and spins its cocoon on the tree, usually attached to the needles. Adult emergence coincides with the hatching of the eggs of *H. fumiferana*. The changes observed during the prepupal stage, which is regarded as beginning with the spinning of the cocoon, follow closely those described by Morris for another Ichneumonid [**26** 197]. The time between emergence from the host and the spinning of the cocoon varied from less than one day for both sexes to five days for males and three for females. The duration of the prepupal (eonymphal and pronymphal) stage in one district in 1943 and another in 1944 averaged 4–5 days for males and 4 for females. Both sexes spent an average of 3 days in the pronymphal stage. The pupal stage averaged 8–10 days for males and 9·5–11 for females.

Hartzell (F. Z.). **Methods of estimating Foliage Area injured by Grape Leafhoppers.**—*Tech. Bull. N.Y. St. agric. Exp. Sta.* no. 277, 49 pp., 12 figs., 26 refs. Geneva, N.Y., 1946.

In New York State, where grape is a major fruit crop, leafhoppers of the genus *Erythroneura* infest all varieties, although the populations fluctuate greatly from year to year and between the four grape-growing regions. When they are very abundant on vines bearing a heavy crop in years in which the weather is unfavourable for ripening, the Jassids seriously affect the quality of the fruit and may decrease the crop during the following year, but a light infestation does not affect either quality or quantity enough to make control measures economic. In an attempt to determine when treatment may be necessary, a study of the relation between the degree of leaf injury and the quality of the fruit was begun in 1943, and a method of estimating the proportion of total leaf surface injured by leafhoppers was developed. Such an estimate is also useful in comparing the cumulative effect of treatments and in separating the injury caused by the overwintered generation from that by the summer generations.

The following is largely based on the author's abstract. Leaves of the Concord variety were used, gathered in 1943 and 1944 in the Keuka Lake and Chautauqua areas, where *Erythroneura comes comes*, Say, is the most important leafhopper on grape. Samples consisting of a definite number of leaves per

vine or per plot, which were representative as regards foliage injury, were collected, the percentage of the area that was injured on a disk 35 mm. in diameter cut from each leaf was estimated by various methods, and the accuracy and speed of the different methods were compared. Two ways of estimating the proportion of leaf area injured were developed. In the first, the proportion injured in 400, 100, 80, 50 or 40 equal squares on the disk was estimated by means of a net micrometer disk attached to a low-power microscope, and in the second the disks were compared with standard disks, for which the degree of injury had been determined by the 400-square method. It was found that the accuracy decreased in proportion to the decrease in the number of squares used per disk and that the matching method had about three-quarters of the precision of the 40-square method. The relative speeds of the various methods were 1, 4, 5, 8, 10 and 160, respectively, for the 400-, 100-, 80-, 50-, and 40-square and matching methods. The estimates took considerable time to make by the square methods, but matching provided a practical, rapid and fairly accurate procedure for estimating injury by grape leafhoppers and may be applicable to estimating leaf injury by other insects. The variation in infestation that usually occurs on each vine and throughout the vineyard necessitated the study of sampling problems and of the various types of error that occurred. Discrepancies between methods of estimation, normal variation, personal or accidental error and positional or constant error are discussed, and methods of reducing experimental and sampling errors are shown.

Hough (W. S.). **Recent experimental Results with DDT on Control of the Codling Moth.**—*Trans. Peninsula hort. Soc. 1945* pp. 19–25. Dover, Del. [1946.]

An account is given of tests to compare DDT with lead arsenate in cover sprays against the codling moth [*Cydia pomonella*, L.] on apple in three orchards at Winchester, Virginia, in 1945. All spray quantities are given per 100 U.S. gals. The results, which are given in tables, showed that sprays of 0·5, 0·8 or 1 lb. DDT in the form of a wettable powder in 7–8 cover sprays gave 94–99 per cent. undamaged fruits, while lead arsenate at 3 lb. in eight cover sprays gave only 70–88 per cent. Six or seven cover sprays beginning with DDT in the first or second and ending on 7th August were as effective as eight covers ending on 17th–18th August, but the percentage of undamaged fruits fell to 92·5 when the third and fifth covers were omitted and the fourth application of DDT was made on 7th August. Treatments comprising seven or eight applications of DDT (4–8 oz.) combined with 3 lb. lead arsenate gave 85·4–95·1 per cent. sound fruits. The percentages of uninjured fruits in the controls, which only received a calyx spray, were 2·8–12·5.

The duration of effectiveness of the DDT deposits was tested by exposing apples picked from sprayed trees to larvae of *C. pomonella*. Two weeks after spraying with 1 lb. or ½ lb. DDT and 6 lb. or 3 lb. lead arsenate, the percentages of larvae that entered the fruits unharmed were 0·7, 6·0, 7·4 and 21·4, respectively. When 6 U.S. quarts oil (Orthol-D) were added to the spray of 1 lb. DDT, the percentage after 35 days increased from 11·6 to 21·4 [*cf. R.A.E.*, A **35** 264]. Laboratory tests in which adults of *C. pomonella* were exposed to fresh spray deposits indicated that more than five hours' exposure was required to produce toxic effects. The mortality percentages after 24 hours' exposure were 30, 56–65 and 97, respectively, for concentrations of 4, 8 and 16 oz. DDT, using material of fine particle size; a powder of larger particle size gave considerably less control. Exposure for 24 hours to the residues from sprays of 8 and 16 oz. DDT applied five days before gave 0 and 36 per cent. mortality, respectively.

DDT residues on the fruit were not easily removed by washing or polishing [*cf.* **34** 106, 107]. Sprays containing 4 or 8 oz. DDT with 3 lb. lead arsenate or of 8 oz. alone, applied 6–8 times ending in early or mid-August, resulted in residues at harvest of 0·05 grain DDT or less per lb. fruit [*cf.* **35** 110] ; residues from sprays of 1 lb. DDT under the same conditions usually exceeded this figure (0·044–0·088 grain per lb.). The addition of oil to DDT sprays doubled or trebled the toxic residue at harvest. Visible residues were more conspicuous from preparations containing a smaller proportion of DDT, indicating that they were largely due to the inert ingredient, and were more readily removed by the polishing machines when Bordeaux mixture was included in the last application or the last but one.

Mites (the European red mite [*Paratetranychus pilosus*, C. & F.] and *Tetranychus schoenei*, McG.) were checked by adverse weather until the second week in August, but by the end of that month they were about seven times as numerous on trees sprayed with DDT as elsewhere in the orchard. The measures taken to control them, which are described, have been noticed from another source [**35** 264].

Rice (P. L.) & Stearns (L. A.). **Results with DDT for Codling Moth Control, Delaware, 1945.**—*Trans. Peninsula hort. Soc. 1945* pp. 26–31. Dover, Del. [1946.]

Experiments in which DDT was compared with lead arsenate for the control of the codling moth [*Cydia pomonella*, L] on apple were carried out in two orchards in Delaware during 1945. The spray formulae and programmes and the results of the tests are given in detail in tables ; suitable fungicides were included in almost all sprays. The quantities of spray ingredients given are per 100 U.S. gals. DDT was the only insecticide in sprays containing it and lead arsenate the sole or principal one in the other sprays. The dates of application of the cover sprays were correlated with the activity of the moth.

The trees in the first orchard received a calyx and three cover sprays containing 3 lb. lead arsenate, followed by seven cover sprays containing 3 lb. lead arsenate or 0·6 lb. DDT. Spraying was carried out between 8th April and 30th July ; dropped fruits were examined on 13th, 24th and 26th July and harvest records and counts of Tetranychid mites were taken on 7th and 9th August. The percentages of fruits that were infested and (in brackets) superficially injured by *C. pomonella* were 28 (33) for lead arsenate and 36 (21) for DDT. The numbers of mites per leaf averaged 16 with lead arsenate and 110 with DDT, and the latter number was sufficient to cause bronzing of foliage and a substantial reduction in the size of the harvested fruits. The toxic residues on these averaged 8 parts per million DDT or arsenic pentoxide, which exceeded the tolerance for arsenic and for DDT [*cf. R.A.E.*, A **35** 110].

The trees in the second orchard received a calyx and first cover spray containing 3 and 4 lb. lead arsenate, respectively, followed by seven more cover sprays. These contained either 4 lb. lead arsenate (with or without 6 U.S. pints summer oil in the second, third and last and ¾ U.S. pint nicotine sulphate in the second and last), 0·8 lb. DDT, 0·4 lb. DDT or a mixture of 0·2 lb. DDT and 2 lb. lead arsenate. Dropped fruits were examined on 10th August, counts of Tetranychid mites were taken on 2nd and 9th August and harvest records were completed on 6th and 7th September. The percentages of apples that were infested and (in brackets) superficially injured by *C. pomonella* were 7 (30) and 6 (26) for lead arsenate with and without oil, 5 (10) for 0·8 lb. DDT, 11 (22) for 0·4 lb. DDT and 7 (20) for the mixture. Mite injury was not heavy except on the trees that received 0·8 lb. DDT, when the population averaged 82 per leaf ; it appeared to increase in direct proportion to the concentration of DDT. The toxic residues on harvested fruit in no case exceeded the tolerance.

Miller jr. (H. W.). **800 Acres with DDT. West Virginia Grower reports on Experience of three Seasons.**—*Trans. Peninsula hort. Soc. 1945* pp. 32–35. Dover, Del. [1946.]

An account is given of a commercial experiment in two apple orchards in West Virginia in which the population of the codling moth [*Cydia pomonella*, L.] and the percentage of injured fruit had risen steadily in spite of heavy lead-arsenate spray programmes and other control measures. The numbers of moths taken in May in ten bait pans, five in each orchard, were 546 in 1943, 1,070 in 1944 and 2,536 in 1945. The percentage of injured picked fruit was reduced from 22 in a heavy crop in 1944 to less than 0·5 in a light one in 1945 by a spray programme including two applications of DDT [amount unstated] against the first brood and two against the second. The first application remained effective for only two weeks, but the later ones for longer; DDT spread better and lasted longer when used with 1 quart summer oil per 100 gals. The sprays did not injure the foliage. An increasing population of Tetranychid mites was effectively controlled by summer oil (5 quarts per 100 gals.) applied on comparatively cool days. Two cover sprays of 4 lb. lead arsenate per 100 U.S. gals. were given in May, and one partial application of 2 lb. 14 per cent. fixed nicotine with 2 U.S. quarts oil per 100 U.S. gals. was made between broods, because insufficient DDT was available.

It is believed that DDT was effective against not only the young larvae but also full-fed larvae seeking sites in which to spin their cocoons, and it also killed many of the adults. No discomfort was experienced from handling DDT powder.

Peterson (A.). **Laboratory Tests showing the Effect of DDT on several important parasitic Insects.**—*Ohio J. Sci.* **46** no. 6 pp. 323–326, 1 ref. Columbus, Ohio, 1947.

Laboratory tests were carried out in Ohio in 1945 to ascertain the toxicity of the dry residue from a DDT spray on orchard foliage to adult parasites visiting the treated leaves. The parasites tested were the Braconid, *Macrocentrus ancylivorus*, Rohw., the Ichneumonids, *Cremastus cooki*, Weed, and *C. forbesi*, Weed, and the Tachinids, *Nemorilla floralis*, Fall., and *Archytas apicifera*, Wlk. The DDT preparation used was a wettable powder (Deenate 25W) containing 25 per cent. DDT.

For testing the parasites individually, the open end of a test-tube containing the insect was inserted into a glass tube lined for 5 cm. with peach foliage that had been sprayed and allowed to dry. By orientation towards the light, the insect was induced to walk over the sprayed foliage into a clean test-tube containing a drop of honey-agar, the time required being 2–10 seconds. The results of numerous tests showed that 60–90 per cent. of adults of *M. ancylivorus* died within 36 hours after walking over a peach leaf that had been sprayed with 0·1 per cent. DDT, but *C. cooki*, *C. forbesi* and *N. floralis* were not affected by this or weaker sprays. When adults of *M. ancylivorus* were exposed for ten minutes to dried sprayed leaves in large test-tubes, the percentage mortality was 100 for 0·1 per cent. DDT and 60–70 for 0·01–0·02 per cent.

In cage tests, which gave the clearest results, wooden boxes measuring $4 \times 4 \times 6$ ins. were used; they had gauze backs facing the light and sliding fronts of wood and celluloid. Each box contained fresh water, honey-aga food and a sprayed or unsprayed peach twig held in water and so arranged that some of its leaves were in contact with the gauze. Batches of 10–25 or more insects, usually less than three days old, were introduced into the boxes, and the results were calculated 36–48 hours later in most cases. The residue from a

spray of 0·01 per cent. DDT gave complete mortality of all five species except in one test with *C. forbesi*, in which it gave 90 per cent. In some tests, concentrations as low as 0·002 per cent. DDT gave complete mortality, especially with *M. ancylivorus* and *A. apicifera*, and even 0·001 per cent. DDT sometimes gave 60 per cent. mortality of *M. ancylivorus*. Among the Hymenoptera, *M. ancylivorus* proved somewhat more susceptible to DDT than the species of *Cremastus*, particularly at dosages lower than 0·0033 per cent., and males and females were equally susceptible. When the sprayed leaves were used again 3–5 days later in the same cages with the same species of parasite, the mortality percentages of *M. ancylivorus* and *C. forbesi* were lower at all dosages below 0·005 per cent. than in the first tests, indicating some loss of toxicity in the interim. In several tests with these two species, more rapid and more extensive mortality occurred when the temperatures averaged about 70°F. than when they averaged 80°F. or more.

In tests during July and August, in which all the parasites were exposed to foliage from trees sprayed with 0·1 per cent. DDT in the orchard, complete mortality was obtained after exposure to foliage sprayed 1–4 weeks previously when the average temperature during the test period did not exceed 72°F., and complete mortality of *M. ancylivorus* after exposure to foliage sprayed seven weeks previously. When the temperature averaged 80°F. or more, the percentage mortality fell somewhat. Rainfall on the sprayed foliage did not reduce the toxicity of the deposit to a point at which parasites could visit the treated leaves without partial or total mortality. When adults of *M. ancylivorus* were exposed at temperatures averaging 82°F. to leaves from peach trees that had been sprayed once with 0·1 per cent. DDT, complete mortality was obtained after exposure to foliage sprayed 15 days previously and subjected to 0·38 in. rain ; when the temperature averaged 68°F., mortality was complete after exposure to leaves sprayed 51 days previously and subjected to 4·08 ins. rain.

SMALL (T.). **Colorado Beetle in Jersey, 1939–1946.**—*Agriculture* **53** no. 10 pp. 450–453, 1 pl. London, 1947.

After the control of the first outbreak of the Colorado beetle [*Leptinotarsa decemlineata*, Say] in Jersey in 1939 [*cf. R.A.E.*, A **29** 63], the insect was not again observed there until 1943, when five isolated adults were found. In 1944, four small outbreaks, in which all stages were present, were inspected and treated as well as possible by spraying and soil treatment. Immediately after the liberation of the island in May 1945, a campaign to eradicate the beetle was begun. Single adults were found in eight places and outbreaks in 38 places. Most of these were mild and covered 100–200 square yards, but four on land that had been occupied by the Germans were severe and involved all stages, the largest area covering eleven acres, and had probably been present before 1945. Hand collection of all stages, spraying with lead arsenate and the growing of trap crops were carried out, and from late August, when carbon bisulphide became available, soil injection was undertaken in all actively infested areas.

In 1946, potato growing was permitted only under licence. The crop was confined to areas planted with potatoes in 1945, in order to reduce the number of fields in which self-sown plants might occur, plantings of less than $\frac{2}{3}$ acre were prohibited, to simplify inspection and spraying, and all crops were inspected once a fortnight and within three days before the lifting of the crop or the destruction of the haulms. Approximately 4,250 acres of early potatoes were planted, and spraying with a mixture containing lead arsenate was begun on 1st May. Infested fields were treated first, and the first application (4,250 acres) was finished by the end of May, the second (3,840 acres) by 22nd June and the third (2,344 acres) by 12th July. Spraying of late potatoes (about 250

acres) was continued at monthly intervals until the middle of September, and one additional application was made early in October to crops of which the haulms were still green. Only one adult (dead and emaciated) was found outside the 46 areas that had been infested in 1945, and 39 of these remained free from infestation. The seven 1946 outbreaks covered only small areas; in five of them no infestation was found after the end of July, and in the other two only four adults and one larva were discovered in August and September.

At the end of 1946 it was considered that the outbreak in Jersey was well under control and that few adults were likely to hibernate. However, in view of the possibility of further infestation from the Continent, continual vigilance was still necessary.

Ripper (W. E.) & Tudor (P.). **The Development of a Helicopter Spraying Machine.**—*Bull. ent. Res.* **39** pt. 1 pp. 1–12, 8 pls., 4 figs., 10 refs. London, 1948.

Seed crops of beet, crucifers and peas often require treatment with insecticides when they are in full vegetation and are likely to be damaged by ground equipment, but aircraft have not been used to apply insecticides in England, because of the risk of drift to adjacent fields and of accidents, which, owing to the dense population and numerous trees and telegraph wires, is high. Work with autogiros in the United States [*R.A.E.*, A **27** 645; **30** 355], indicated that rotary-wing aircraft would be safer and more convenient to use than aircraft with fixed wings, and since sprays are influenced less by weather and are therefore more satisfactory than dusts in England, experiments were undertaken in 1945–46 to determine whether the interference of the slipstream of a helicopter with the ground or vegetation could be used to produce a spray deposit similar or superior to that given by ground equipment. A Sikorski-type Y.R.4.B. helicopter, the specifications of which are given, was used for the tests. The shape of the slip-stream was studied by using smoke or liquids as markers and by observing the ripples made when the aircraft flew over stationary water. It was found that the slipstream is bell-shaped when the helicopter is in the hovering position, and the cross-section at the height of the fuselage forms an annulus in which the difference between the outer and inner radii is approximately two-thirds of the rotor diameter, but when the helicopter moves slowly forward, the cross-section of the annulus becomes elongated into a parabola-shaped curve with its apex forward in the direction of flight. On reaching the ground, the slip-stream flattens out and spreads along it with considerable rebounding.

For tests on the distribution of spray droplets, the helicopter was fitted with a specially designed spray apparatus, mounted in place of and above the passenger's seat. A 10-gallon reservoir holding 6 gals. liquid with an air-cushion above it was connected at the bottom with a spray bar by a tube in which was the pilot's control valve. Another tube connected the top of the reservoir to a high-pressure air-storage vessel and was joined by a third tube to a commercial nitrogen cylinder, which, by means of a suitable arrangement of valves and gauges, maintained pressures of 1,100 lb. per sq. in. in the high pressure cylinder and 300 lb. in the liquid storage container. The spray bar was equipped with conventional eddy-chamber nozzles and was mounted on a cantilever type of support, which allowed the use of three positions. These were in the most forward arc of the annulus extending 15° on each side of the longitudinal axis of the aircraft, in the arc extending 15° on each side of the perpendicular to the longitudinal axis, and the arc intermediate between the two. The distance between the spray bar and the rotor hub and the spray bar and the rotor blades could also be varied. Water was found to be a suitable liquid for testing the distribution of the spray droplets, which was done by

means of cards that had been sensitised with Kiton green and so became green on contact with water. The cards were mounted on pegs, and each peg supported one horizontal and two vertical cards, one of the latter being in line with and the other at right angles to the line of flight.

The following is largely the authors' summary of the results. The best all-round coverage was given when the spray-bar was in the intermediate arc of the slip-stream, and in this position the spray deposit was less influenced by alterations in the control-surfaces of the helicopter. To obtain a fairly wide swathe of approximately 70 ft., the equivalent of two rotor diameters, a forward speed of 6–8 miles an hour was found to be the best, and it was observed that the spray-laden slip-stream not only gave good coverage of the upper surfaces of the leaves and the vertical surfaces of the plants outside the rotary periphery, but, in certain positions of the spray-bar, produced a cover of the lower surfaces of the leaves in rebounding. In order to obtain maximum deposit and a good coverage of the lower surface of the leaves, the spray-bar must be not more than 6 ft. above the ground. Helicopter spraying is dependent on the wind, and in wind velocities above 12 miles an hour, uniform coverage does not appear to be feasible. The performance of the flattened-out slip-stream and rebound depends on the type of crop, and as this affects the deposit to a considerable degree, it is to be investigated further. The forward portion of the slip-stream was found to give a more even spray deposit than the aft portion, because in the latter case, vortices are caused by the rotor blades, which affect the spray deposit. In view of its limitations as regards speed and dependence on wind velocity, economic application of spray chemicals by helicopter at a degree of efficiency equal to that of ground machines is only possible with one capable of carrying a heavy load, which could accommodate sufficient spray liquid to feed three spray bars and thus make use of a greater part of the slip-stream annulus.

HINTON (H. E.). **A Synopsis of the Genus *Tribolium* Macleay, with some Remarks on the Evolution of its Species-groups (Coleoptera, Tenebrionidae).** —*Bull. ent. Res.* **39** pt. 1 pp. 13–55, 33 figs., 6 refs. London, 1948.

In this revision of the species of *Tribolium*, with which *Aphanotus* is regarded as congeneric, the author discusses the 26 known species with reference to their evolution and the countries from which they originated, gives a key to the adults and describes 17 new species and one new subspecies. He also describes two new forms of *T. indicum*, Blair, from the Anglo-Egyptian Sudan and Senegal, respectively, and states that the only known record of the typical form from Africa is from French Somaliland in 1893.

WRIGHT (D. W.) & GEERING (Q. A.). **The Biology and Control of the Pea Moth, *Laspeyresia nigricana*, Steph.**—*Bull. ent. Res.* **39** pt. 1 pp. 57–84, 1 pl., 6 figs., 14 refs. London, 1948.

Investigations on the bionomics and control of *Cydia* (*Laspeyresia*) *nigricana*, Steph., on peas [*cf. R.A.E.*, A **14** 217] were carried out in eastern England, chiefly in Essex, in 1945–47. Emergence of the moths in field-cages continued from mid-June until late July or early August, and in 1946 reached a peak on 20th July; moths appeared one week earlier in the field. Attempts to trap the moths with molasses baits and adhesive bands were unsuccessful and they were difficult to sweep when sheltering in pea crops, though they could be caught at crop height when in flight. The moths were more numerous in dense than in sparse vegetation, but did not concentrate in or near hedges or windbreaks. Activity, which began at 2 p.m. and reached a peak at 4–6 p.m., occurred under all conditions of sun and cloud, provided that temperatures of

63°F. in full sun or 65°F. in partial cloud were reached. Normal flight occurred at wind velocities of 0–4 miles per hour at crop height. The summer of 1946 was unusually wet, but at a place at which temperatures of at least 65°F. were reached on 39 of the 55 days on which the adults were present, pod infestation was later as high as 20 per cent. In the insectary, oviposition began 5–11 days after emergence, with an average of 8. The eggs were deposited at random on the upper half of the plants, over half of them on the lower surfaces of the leaves. They were found only in fields in which flowering had begun, though they sometimes occurred there on plants not yet in flower.

The larvae hatched in 9, 6 and 3 days at 59, 68 and 77°F., respectively, and crawled about the plant for 24 hours before entering the pods, which they attacked at all stages until they became parchment-like ; the entry hole heals in a few days, forming a small blister. Single larvae damaged up to six seeds per pod, but only 1–2 were usually severely injured. Maximum attack occurred at the end of August. The time spent in the pods was 18–30 days in the insectary, being longer at the end of the season, and the full-fed larvae leave the pods and enter the soil, where they spin cocoons. In early September 1946, when, but for wet weather the crop would have been harvested, 46·5 per cent. of the larvae were still in the pods. When plants were allowed to dry out in the laboratory until by the end of the month their condition resembled that of plants towards the outside of the field stacks, only 6·4 per cent. of the larvae remained ; normally not more than about 10-15 per cent. of the larvae are transferred to the stacks. A few larvae, mostly immature, remain in the pods even when the seed crops are harvested ; among some kept in the laboratory from August 1946 until March 1947, only those that had reached the fourth instar survived the autumn. They spun cocoons either in the pods, where they did not survive after December, or within the seeds, where they remained healthy until spring ; two healthy larvae were found in a commercial seed sample in March, and the species is probably distributed in this manner.

Overwintering normally occurs in fields in which peas have been grown and in the soil of sites on which the peas harvested dry are stacked. When the peas are harvested green, most of the larvae are removed from the field, but many have entered the soil already, and many pods are overlooked. The numbers of larvae per acre in pods overlooked at harvest in five such fields were estimated at 7,300–67,400. Larvae were numerous in the soil under haulms heaped into small cocks to dry and were not destroyed when the latter were burned. Overwintering larvae are most numerous in fields of peas grown for seed. The total larval populations per acre at harvest on seed crops of two varieties were estimated to be 607,000 and 1,020,000, respectively ; of these, 300,000 and 685,000 had left the pods by the time the crop was cut and many more before it was stacked, but 10–50 per cent. of the total population was transferred to the stack. The larvae were distributed all over the stack site, but were most numerous near the edge ; the maximum concentration was 1,737 per sq. yard.

Of larvae in the soil, 92·6, 4·7 and 2·7 per cent. were found at depths of 0–2, 2–4 and 4–10 ins., respectively. In April, those at the lower depths migrated to within 2 ins. of the surface, where they and those that had overwintered at that depth constructed thin cocoons in which they pupated. Larvae were able to pupate successfully from depths of up to 12 ins., but mortality was high when they were placed at a depth of 24 ins. Samples taken from stack sites in the summers of 1945 and 1946 indicated that a few larvae had passed two winters in the soil before pupating. Since larvae collected in September and kept at 68°F. for six months did not complete their development, although others collected in January after experiencing soil temperatures of 5°C. [41°F.] and lower for a considerable period gave rise to

adults after 56 days at 59°F., it is considered unlikely that a second generation would develop under normal weather conditions in Britain. After development was resumed, adults emerged in 80 days at the soil temperatures of a warm spring and in 118 at those of a cold one. Exposure to 23°F. for 17, 24 and 31 days did not increase mortality. Pupae were present from 3rd June to 9th July in 1946, the pupal stage lasting 12–14 days in the field.

Other plants found infested were *Lathyrus pratensis*, *L. odoratus*, *Vicia cracca* and *V. sativa*, on which the percentages of pods attacked were 26·5, 3, 12·5, and 0·28, respectively. Although *V. cracca* and *V. sativa* are common in Essex, populations are considerably smaller on them than on cultivated peas.

The parasites reared from the larvae [*cf.* **27** 38] were *Ascogaster quadridentata*, Wesm., *Glypta haesitator*, Grav., and *Hemiteles ridibundus*, Grav. The total percentage parasitism varied from 33·7 to 50 in 1946; *H. ridibundus* was the commonest species, and emerged from up to 42·5 per cent. of the larvae under stacks in Essex, while the maximum percentages for *A. quadridentatus* and *G. haesitator* were 15·4 and 20·2, respectively. These two species emerged during the emergence period of the host, but *H. ridibundus* did so over a longer period, though the peak occurred at the same time. All three parasites were relatively abundant, so that the liberation of laboratory-reared stocks would not be of great value. Mortality among overwintering larvae of *C. nigricana* due to other causes, chiefly fungi [**27** 39], averaged 6·6 per cent. in 1945–6.

Cultural control measures were investigated in 1946. Three varieties of peas that are grown commercially for harvesting green and two grown for drying differed widely in susceptibility to attack; infestation was greater in the later varieties and also in those producing abundant foliage, in which the moths shelter. The percentages of pods attacked on successive sowings of one variety made on 22nd March and at monthly intervals in April, May, June and July were 1·52, 18·7, 25·6, 1·06 and 0, respectively. Infestation was increased on peas mixed with oats, as a result of the cover provided by the latter and the reduced number of pods produced by the peas. The numbers of moths that emerged from plots that were left undug or dug to depths of 8–10 or 14–16 ins. in April did not differ significantly, but emergence was delayed by the deep digging. Ploughing or digging to destroy the overwintering larvae is of little value unless the ground can be disturbed to depths exceeding 12 ins. Preventive measures recommended for areas where peas are grown for harvesting green comprise reducing or eliminating the cultivation of peas for seed and following any seed crops with one requiring cultivation early in the following season to destroy self-set plants, disposing of crop débris immediately after harvest, the use of early maturing varieties and of sites removed as far as possible from fields under peas in the previous season, clean cultivation, and cutting back *V. cracca* and *L. pratensis* and harvesting forage crops that include peas early in July.

An emulsion spray containing 0·5 per cent. DDT considerably reduced attack in preliminary tests in 1945, and further experiments were made in 1946 in three fields in Essex. The materials used were a solution of DDT in solvent naphtha emulsified with cyclohexylamine dodecyl sulphate and a suspension of DDT with particles of an average diameter of 20μ and a spreader. Power equipment with three nozzles for each row, of which one was directed downwards and the two others into the sides, was used, and the sprays were applied at a pressure of 300 lb. per sq. in. as a fine mist that left a fine deposit of DDT chiefly on the upper surfaces of the leaves, although the lower surfaces and the stems, flowers and pods were also partly covered. None of the sprays damaged the plants. Sprays containing 0·5 per cent. DDT were applied to peas grown for seed in a field in which a heavy infestation had occurred in the previous year, on 8th July (12 days after the beginning of the flowering period), and 24th July, at rates of 210 or 140 gals. per acre. Samples

were taken at both green and dry harvest (6th and 20th August). The percentages of infested pods at the first and (in brackets) second sampling dates were 12·1 (19·4), 20·9 (21·4) and 6·8 (5·3) for the emulsion applied at the higher rate on 8th July, 24th July or both dates, respectively, 5 (5·4) for the lower rate on both dates, 13·8 (18·7) for the suspension applied at the higher rate on 8th July, 19 (23·7) for the same treatment at the lower rate, and 8·7 (8·6) for the suspension on 8th July and the emulsion on 24th, both at the higher rate, as compared with 40·8 (49·1) on control plots and 57·5 (66·7) in an untreated corner of the field; the first application prevented attack almost completely for at least 16 days, except on leaves and pods that developed after treatment. Immature larvae were scarce at dry harvest on plants that received two applications or one late one, and the late spray therefore gave protection for four weeks.

Different concentrations of DDT were tested on two other crops, both for picking green, of which one was ½ mile distant from the nearest field in which peas had been grown in 1945 and the other adjoined the site of a heavy infestation in that year. The sprays were applied in early July, shortly after the flowers appeared. The percentages of pods infested at green picking and (in brackets) at dry harvest in the first were 3 (5·4), 3·6 (8·7), 6·3 (14) and 7·2 (13·1) for 0·75, 0·5, 0·25 and 0·125 per cent. DDT as the emulsion at 210 gals. per acre, respectively, as compared with 19·6 (26·2) in the controls, and at green picking in the second, 11, 13·2 and 15·5 for 0·5, 0·25 and 0·125 per cent., as compared with 40·2. Statistical analysis of the results obtained in the second field showed that all the treatments were significantly better than none, but did not differ significantly among themselves. Since the presence of small larvae in the pods of green peas is of little or no commercial importance, the percentages of pods attacked by medium-sized and large larvae were calculated for the different treatments. The results showed that not more than 3 per cent. were so infested following single applications of the 0·5 and 0·25 per cent. DDT emulsions, and this, compared with 20 per cent. serious infestation in the controls, can be regarded as commercially satisfactory.

On the basis of this work, it is recommended that peas to be harvested green should receive one application of an emulsion spray containing 0·5 per cent. DDT at a rate of 140 gals. per acre 7–10 days after the first flowers appear on crops sown in late April or May and seven days after the adults of *C. nigricana* appear on earlier ones. Peas to be harvested dry should receive a second application about 14 days later.

Small-scale tests at Cambridge, in which DDT sprays were applied to both leaf surfaces or to the upper one only, indicated that partial coverage was as effective as almost complete coverage. Two heavy applications of an emulsion spray containing 0·009 per cent. (by weight) γ benzene hexachloride was of no value when used alone or combined with a suspension containing 0·5 per cent. DDT. A dust containing 0·39 per cent. (by weight) γ isomer applied at a rate of 4 cwt. per acre on 31st June and twice subsequently at ten-day intervals was also ineffective.

WALOFF (N.). **Development of *Ephestia elutella*, Hb. (Lep., Phycitidae) on some natural Foods.**—*Bull. ent. Res.* **39** pt. 1 pp. 117–130, 4 figs., 11 refs. London, 1948.

The investigations described were carried out in connection with studies of a natural population of *Ephestia elutella*, Hb., breeding on Manitoba wheat stored in bulk in London [*R.A.E.*, A **36** 210–214], and a selected stock that was bred on middlings and did not diapause at 24–25°C. [75·2–77°F.] was used. At a relative humidity of 70 per cent. and a constant temperature of 25°C., the complete larval stage lasted for an average of 35·9 days, but at temperatures

of 17 and 21°C. [62·6 and 69·8°F.] the larvae fed for 66·9 and 65 days, respectively. Under warehouse conditions, the combined incubation and feeding period last 60–70 days at an average grain temperature of 16·9°C. [62·42°F.]. The pupal period averaged 14 days at 25°C. and 21 days at the other two temperatures ; it was very variable, even at constant temperatures, and in the warehouse sometimes lasted 30–40 days in May–June. Larvae kept at 25°C. did not diapause, but 59 of 64 kept at 21°C. and 19 of 44 kept at 17°C. remained in diapause for up to 400 days. Larvae that developed at the lower temperatures consumed more food than those at higher ones, and the weight of the resultant moths was also greater, but moths that had developed at 21°C. were slightly heavier than those that had developed at 17°C. It is concluded that the utilisation of food is similar at the two higher temperatures, but less efficient at the lower one. More larval substance by weight was needed to produce male than female adults. In general, the larvae fed only on the embryo of the wheat, though they attacked the endosperm if food was scarce. First-instar larvae fed within the grains, which they left to moult, often returning to the same one ; after the second instar, they fed outside the grains. The number of embryos attacked by one larva averaged about 48 for all three temperatures ; at the lower ones, where feeding was prolonged, the embryo is probably more completely destroyed and some of the endosperm also attacked. Unpublished data obtained by O. W. Richards and T. A. Oxley show that the larvae tend to attack the smaller grains, although these represent only a low percentage of the grain bulk.

When the larvae were reared at 25°C. and 70 per cent. relative humidity on foods on which they occur naturally, it was found that the latter could be arranged in three groups according to the extent to which they induced diapause. Larvae reared on Manitoba wheat, wheat embryos, unpolished rice, of which only the embryo was eaten, English oats, tobacco, dried figs and soy-bean flour containing 1·3 per cent. fat did not diapause. Development was fast and survival high among larvae reared on the first three. A larva required about 96 rice embryos. Both the embryo and endosperm of oats were attacked, and each larva required six grains ; survival was considerably increased when the husks were removed. The distribution of the larvae in oats and unpolished rice stored in bulk resembled that in Manitoba wheat [**36** 214], but some penetrated to depths exceeding 5 ft. Survival on tobacco and dried figs was very low, and attempts to rear the larvae on raisins, dates and prunes were unsuccessful. A small percentage (14·3–33·3) of the larvae reared on soy-bean flour with a fat content of 7·3 per cent., cacao beans and ground-nuts, all with a high fat content, and on dried peas entered diapause. Only 8·9 per cent. survived on whole cacao beans and 32·3 per cent. on beans that had been cut up. The larvae entered and fed on the internal portion of Ceylon, Trinidad, West Africa and Bahia cacao beans, but remained outside Venezuela beans and fed on the outer coat and cotyledons ; attempts to rear the larvae on seed coats of Ceylon cacao beans were unsuccessful. The vitamin B_1 contents of whole Venezuela and Ceylon cacao beans and of their outer coats and internal portions were all high enough (0·21–1·2 mg. per 100 gm.) for larval requirements, but that of the seed coat of Venezuela beans was highest. Survival among larvae reared on English wheat, white flour, dried beans and an insufficient number (ten) of grains of Manitoba wheat, all of which have a high starch content, and an artificial diet in which starch was the only carbohydrate, was fairly low. The development of the surviving larvae was slow, and most of them entered diapause. All those reared on English wheat, of which 12 grains were required, and ten grains of Manitoba wheat entered diapause ; the embryo and endosperm of both were attacked. Those reared on white flour grew very slowly and 80 per cent. entered diapause. Only eight of 20 reared on the artificial diet survived and six of these entered

diapause. It is suggested that diapause may be induced by the lack in foods of this group of a substance essential for normal development, possibly of a vitamin necessary for the production of pupation hormone.

Larvae reared on Manitoba wheat at 25°C. and 70 per cent. relative humidity passed through 5–6 instars, but when the relative humidity was reduced to 35·5 per cent., the number was increased, in one case to as many as 12. The growth curves, obtained by measuring the head capsules of successive instars, approximated to Dyar's law, but the ratio of increase fell off in the last two instars. The prepupal stage is subdivided into five stages on the basis of withdrawal of ocellar pigment, all mobility being lost in the fourth and fifth stages.

Evans (J. W.). **A new Species of *Erythroneura* from Fiji (Homoptera, Jassidae).** —*Bull. ent. Res.* **39** pt. 1 p. 131, 1 fig. London, 1948.

Erythroneura leveri, sp. n., is described from male adults collected on bean in Fiji, in August 1943. It is stated by R. [J.] A. [W.] Lever to be "a vector of a leaf-crinkle on leaves of Madagascar beans (*Phaseolus lunatus*) and cowpea (*Vigna unguiculata*)".

Lever (R. J. A. W.). **Entomological Notes.**—*Agric. J. Fiji* **16** no. 4 pp. 98–103, 32 refs. Suva, 1945.

The author reviews records in Fiji of adults of *Anomocaulus fulvovestitus*, Fairm., on pineapple [*cf. R.A.E.*, A **29** 389; **30** 522] and states that in 1945 they caused extensive damage to leaf bases of *Pandanus tectorius* and *P. thurstonii* in Viti Levu and some damage to *P. tectorius* in islands of the Lau Group. He concludes that this Dynastid occurs throughout the Fiji Islands with *Pandanus* as its original food-plant. Damage to *P. tectorius* by larvae of the weevil, *Diathetes pandanae*, Zimm. [*cf.* **28** 399] was also observed on one of the Lau Islands.

Adoretus versutus, Har., of which the nomenclature, distribution, bionomics and control are reviewed, is widespread in the Fiji Islands, where it was at one time erroneously considered to be *A. tenuimaculatus*, Waterh. [**4** 122; **6** 237; **7** 312; **8** 297; **10** 593]. Records are given of the plants attacked by the adults in Fiji; they often feed on the leaves of rose and were very injurious to young cacao in 1916–18. The author has observed defoliation of *Hibiscus tiliaceus* to be common. The immature stages are spent underground, and the larvae feed on roots, chiefly of grass. The egg and pupal stages lasted about 7 and 10 days, respectively, in February and March 1945, and healthy larvae have been kept in moist soil with grass roots for periods of up to four months. In 1945, rose bushes were effectively protected by dusting with 3 per cent. DDT in colloidal sulphur or musty flour, although some of the tests were nullified by heavy rainfall.

Lever (R. J. A. W.). **Entomological Notes.**—*Agric. J. Fiji* **17** no. 1 pp. 9–15, 32 refs. Suva, 1946.

The author states in a note on mites in Fiji that the correct name for the species on copra recorded as *Caloglyphus mycophagus*, Mégn. [*cf. R.A.E.*, A **28** 380] is *C. berlesei*, Michael. Other mites of economic importance in Fiji include, in addition to species already noticed [**14** 103; **27** 641], *Rhizoglyphus echinopus*, Fum. & Rob., on sweet-potato tubers. The species of *Dirhinus* that was introduced against fruit-flies [*Dacus* spp.] in 1937 [**26** 59] has been identified as *D. giffardi*, Silv. Since it proved less effective than *Tetrastichus giffardianus*, Silv., mass breeding was abandoned in 1943. In September 1941, larvae of *Stictoptera subobliqua*, Wlk., caused heavy though localised damage at Waimaro to leaves of *Calophyllum inophyllum* [*cf.* **31** 41]. Living larvae, pupae and

adults of the Cerambycid, *Phoracantha senio*, Newm., were intercepted during 1945 at Lautoka and Suva, under the bark of logs of *Syncarpia laurifolia* imported from Australia ; wood of this species was hitherto believed to be immune from attack by borers on account of its resin.

In January 1946, larvae of *Acritocera negligens*, Btlr. [*cf.* **27** 212 ; **32** 167] were found mining in the leaf butts of coconut on Viti Levu, the eggs being laid at night on the fibrous leaf stipules. This injury is more serious than that previously attributed to this Cossid, since the damage in some cases weakened the leaf butts that support the fruiting branches on which the nuts are borne. Larvae of *Marasmia venilialis*, Wlk., were numerous on rice on Taveuni, Vanua Levu and Ovalau in 1944 [**35** 43]. They discolour the leaves and roll them into a tube in which they pupate. This Pyralid, the distribution of which is given, also feeds on Para grass (*Brachiaria mutica*) and *Alternanthera sessilis*, in Fiji ; it normally feeds on wild grasses in India, but sometimes damages rice there. Light parasitism by an Ichneumonid, possibly *Cremastus* sp., and a Chalcidoid was observed in one area. Preliminary tests showed that sprays containing 1 per cent. DDT were promising on a small scale, and in subsequent tests, a spray of 1 oz. DDT and 5 fl. oz. of a commercial spreader in 3 gals. water gave good control of the Pyralid but caused slight scorching of the rice. A spray of 1 oz. DDT in 2 fl. oz. xylene, made up to 50 fl. oz. with water, was effective against *Nacoleia diemenalis*, Gn., on beans, and did not injure the foliage.

In a note on insects in Tonga and Samoa, it is stated that typical symptoms of the bunchy-top disease were observed on banana in Tonga in 1946. The virus is transmitted by *Pentalonia nigronervosa*, Coq., which was not known to be present there. The beetle recorded as *Aulacophora* sp. on cucurbits in Tonga in 1940 [**30** 371] has been identified as *A. similis*, Ol. It was again observed there on cucurbits in 1945 and was also taken on them in New Caledonia, the New Hebrides and the Solomon Islands and on sweet potato in the Solomons. Larvae that destroyed the grass on an airfield in Tonga were identified in 1941 as *Spodoptera mauritia*, Boisd. ; they were parasitised by *Macrocentrus* sp. and another Braconid. In Samoa, *Hyblaea puera*, Cram., was observed for the first time ; it was damaging young teak leaves on a cacao estate on the northern coast of Upolu Island.

Kapuściński (S.). *Megastigmus kuntzei* **n. sp. (Hymenoptera, Chalcididae), a destructive Insect feeding on Seeds of common Juniper** (*Juniperus communis* **L.).** [*In Polish.*]—*Trav. Inst. polon. Rech. for.* (A) no. 47, 129 [+24] pp., 10 pls. (1 col.), 2 maps (1 fldg.), 37 refs. Cracow, 1946. (With a Summary in English.)

As juniper (*Juniperus communis*) is of value in Poland as undergrowth in pine stands and in the afforestation of sandy areas, and the fruits are used in medicine, investigations were begun on pests attacking the fruits and seeds. One of these was found to be a species of *Megastigmus* that was reared in 1943 and is here described as *M. kuntzei*, sp.n. All stages of this Torymid are described (the adults also in English), characters are given distinguishing it from *M. wachtli*, Seitn., its distribution is shown on a map and a key is included distinguishing the injury it causes from that due to other pests of juniper. Fruits showing typical exit holes were received from Rumania.

Observations showed that *M. kuntzei* has one generation a year. The adults emerged in the second half of July in the lowlands and in the first half of August in higher localities and were present for about three weeks. They are attracted by light and warmth and occur in the upper part of the bushes, where they are active throughout the day in sunny weather, feeding on dew

and the waxy film in the groove on the upper side of the needle-like leaves. The males emerged somewhat before the females and disappeared sooner; under favourable conditions, males lived for 3–4 days and females for 6–8. Pairing occurred in the evening after the females emerged, and eggs were deposited on the following day, if it was sufficiently warm, and thereafter during life, usually in one of the three seeds within the first-year fruits. Though not more than one larva occurred in a seed and there was usually not more than one exit hole on a fruit, about 13 per cent. of the damaged fruits had two or three exit holes.

Eggs laid during the second half of July hatched in a fortnight. The larvae fed on the contents of the seeds until the first frosts, in November, when they hibernated. Feeding was resumed in April and continued to the end of June. The process of feeding is described; it did not check the development of the fruits, so that infested fruits did not differ in appearance from healthy ones. Pupation took place in the hollowed-out seed in June or July, and the prepupal and pupal stages together lasted about a fortnight. The percentages of fruits infested varied from 3·9 to 56·3 according to locality.

The activity of the adults was checked by cool weather and rain, and they died during heavy showers or in the absence of dew. The seeds are also injured by the Pentatomid, *Chlorochroa juniperina*, L., and the mite, *Eriophyes quadrisetus typicus*, Thoms., before the adults of *M. kuntzei* appear, and this somewhat reduces the number of fruits available.

The adults are destroyed by two unidentified spiders, and the mature larvae are parasitised by *Trichomalus laevinucha*, Thoms. After destroying the host, the larva of this Pteromalid overwintered in the hollowed-out seed and pupated in the following spring, the adult emerging at the end of May from the ripe fruit. Thus, *M. kuntzei* emerged from fruits that were one year old and the parasite from those that were two; their exit holes can be distinguished. For medical purposes, the fruits are gathered when they are one year old, and the parasites in them are destroyed, so that *T. laevinucha* is rare in localities in which the fruits are so collected every year.

Grandori (R.). **Esperimento di lotta contro le altiche del lino.** [An Experiment on the Control of the Flax Flea-beetles.]—*Boll. Zool. agr. Bachic.* **13** fasc. 2 pp. 3–7, 1 fig., 1 ref. Milan, 1946. **Nuovi esperimenti di lotta contro le altiche del lino** (*Aphthona euphorbiae* **Schrank e** *Longitarsus parvulus* **Payk.**) **mediante D.D.T.** [Further Experiments with DDT against the Flax Flea-beetles, *A. euphorbiae* and *L. parvulus*.]—*T.c.* pp. 18–40, 3 figs., 1 ref. (With Summaries in English, French & German.)

It is stated in the first of these papers that *Aphthona euphorbiae*, Schr., and *Longitarsus parvulus*, Payk., have for several years caused severe damage to flax in Italy, particularly in the central regions, and could not be satisfactorily controlled, until, in 1944, preliminary experiments were carried out in Lombardy, with Gesarol (4 per cent. DDT in an inert powder). Two or four applications were made, and the Gesarol was applied at 1 or 2 per cent. as a spray and at the rate of 0·3 oz. per sq. yard as a dust. Since the main injury is caused by the larvae that hatch from the eggs laid in the collar of the plant by the overwintered adults, it is essential to destroy the latter before they have oviposited. The treatments were therefore begun on 19th April, when the first adults were observed and the plants were 3–4 inches tall, and repeated at intervals of 2–3 days. By 24th April, no living flea-beetles could be found in the treated plots, though many dead ones were seen. The yields at pulling were not much affected by the number of applications or by the concentration of the sprays, were slightly higher for the sprays than for the dust, and, for all treatments together, averaged over 50 per cent. more than on untreated plots, though infestation was light.

Further experiments, described in the second paper, were carried out in 1946. Owing to the extremely dry spring, germination and plant growth were extremely poor in the Marches, and infestation was also light. Dusts of Gesarol at 0·3 and 0·15 oz. per sq. yard gave up to double the yield of untreated plots, in some areas, as did much lower rates in others, but the results were variable and not always attributable to the treatments. Conditions were better in Lombardy, and infestation was heavy. In one area an application of Gesarol at 0·15 oz. per sq. yard on 10th April, when the plants were wet with dew, followed by one of Gyron (5 per cent. DDT) at half the rate on 17th, gave good control, which was reflected in the condition of the plants, and when the plants were pulled on 18th June, the yield of the treated plots was 50 per cent. greater than that of the controls. In another area, in which attacks had already begun, one application of Gyron at 0·15 oz. per sq. yard on 22nd April reduced the numbers of adult flea-beetles ten days later by nearly 80 per cent., as compared with the controls, so that a second treatment was not necessary, and more than doubled the yield. In a field near Milan, in which the flea-beetles appeared on 1st April, as soon as the flax was up, Gesarol as a 1 per cent. spray, and Gyron dust were applied on 1st-3rd April and again on 4th. Good control was obtained, and the plants were in good condition at pulling in late June. The total amounts of DDT applied were 0·06 oz. per sq. yard for the spray and 0·34 oz. for the dust. The treatments were about equally effective and more than doubled the yield.

Simonetta (E.). **Studio sul** *Cemiostoma scitellum* **Zell. (Nota preliminare.)** [A Study of *Leucoptera scitella*. Preliminary Note.]—*Boll. Zool. agr. Bachic.* **13** fasc. 2 pp. 8–17, 2 figs., 5 refs. Milan, 1946. (With Summaries in English, French and German.)

The bionomics and control of *Leucoptera* (*Cemiostoma*) *scitella*, Zell., are discussed from the literature [*cf. R.A.E.*, A **22** 436; **25** 150]. In 1942, apple trees in an orchard near Stradella, in the Province of Pavia, became infested by this Tineid; it was satisfactorily controlled until 1945 by sprays of nicotine sulphate, but in that year the insecticide was no longer obtainable and the infestation reached outbreak proportions. All the trees were attacked, the mined leaves dried up and fell and the fruits did not mature; a neighbouring orchard was also infested. Contrary to the experience of Favard [**22** 436], the orchards were not neglected, and pear trees interplanted with apple were not attacked. There were some differences in varietal susceptibility. The eggs, which are described, were laid on the lower surfaces of the leaves, and the larvae mined through the shells straight into the leaf, in which they formed spiral galleries, working outwards from the centre. Up to 87 mines were observed in a single leaf. The full-fed larvae emerged from their mines and wandered in search of slightly concave surfaces on which to spin their cocoons. First-generation larvae constructed them mainly on the leaves, pupated two days later and gave rise to adults after a further eight days. Overwintered cocoons containing pupae were observed in cracks in the bark and on the lower sides of the branches in March, but it was not known whether pupation occurred before or after the winter; no hibernating adults were seen.

In 1946, Gesarol dust [4 per cent. DDT], applied in early May against the adults, did not prevent the formation of numerous mines, and sprays containing one or two per cent. Gesarol, with the addition of an adhesive, were ineffective against the larvae. Of 227 overwintered cocoons collected in the spring of 1946, only 27 contained healthy pupae; the adults appeared to have emerged from 77, and the remainder were parasitised. From 534 that were kept at 28°C. [82·4°F.], there emerged 82 adults of *Leucoptera* and 93 unidentified Chalcidoids, some of which belonged to the genus *Pleurotropis*. A parasite of the larvae that pupated in their mines was observed in small numbers.

Fransen (J. J.), Westenberg (L.) & Terpstra (P.). **Chemisch en biologisch onderzoek van verschillende pyrethrumpoeders.** [Chemical and biological Tests of different Pyrethrum Powders.]—*Tijdschr. PlZiekt.* **53** pt. 1 pp. 1–10, 11 refs. Wageningen, 1947. (With a Summary in English.)

Laboratory experiments carried out in Holland in 1939–43, a detailed account of which is given, showed that pyrethrum powders prepared from the flowers of *Chrysanthemum* (*Pyrethrum*) *cinerariaefolium* grown in Holland were similar in pyrethrin content to imported powders and were as effective as the latter against larvae of *Pristiphora* (*Lygaeonematus*) *abietina*, Christ, *Diprion pini*, L., and *Bombyx mori*, L.

Maan (W. J.). **Zaadbehandeling met D.D.T. tegen de uienvlieg.** [Seed Treatment with DDT against the Onion Fly.]—*Tijdschr. PlZiekt.* **53** pt. 1 pp. 11–13. Wageningen, 1947. (With a Summary in English.)

Until recently, seed treatment with mercurous chloride (calomel) was the only effective method of protecting onions and leeks against injury by *Hylemyia* (*Chortophila*) *antiqua*, Mg., in Holland [*cf. R.A.E.*, A **34** 68]. In field tests in 1946, its effectiveness was compared with that of dusts of 25 or 50 per cent. DDT in talc. Onion and leek seeds were coated with a solution of a proprietary glue preparation and thoroughly mixed with the insecticidal dusts, after which a quantity of mercurous chloride equal in weight to that of the seed and a quantity of the 50 per cent. DDT dust equal to about 40 per cent. of it adhered. In a locality with sandy soil, the percentage infestation of the plants averaged 7 for seed treatment with either DDT dust, 8 for mercurous chloride and 14 for no treatment, and in another with light loam soil, it averaged 2 for the 50 per cent. DDT dust, 6 for the 25 per cent. dust, 5 for mercurous chloride and 15 for no treatment. Treatment with DDT was much cheaper than with mercurous chloride and did not appear to reduce germination or growth, as did the latter.

Fulmek (L.). **Wirtsindex der Aleyrodiden- und Cocciden-Parasiten.** [Host Index of Parasites of Aleurodids and Coccids.]—*Ent. Beih. Berl.* **10** pp. v, 1–100, refs. Berlin, 1943.

Lindinger (L.). **Die Schildlausnamen in Fulmeks Wirtsindex 1943.** [The Nomenclature of the Coccids in Fulmek's Host Index, 1943.]—*Arb. morph. taxon. Ent. Berl.* **10** no. 2–3 pp. 145–152. Berlin, 1943.

An alphabetical list is given of 457 Aleurodids and Coccids, showing their insect enemies (parasites and predators) in various countries, the insect enemies of the latter, and in some cases the plant on which the attack occurs, followed by others of the parasites and predators, with references to their hosts in the main list, and one in which these natural enemies are arranged according to the number of host species attacked. About 1,000 parasites and predators are included, some 900 of the former being Chalcidoids.

The author of the second paper criticises the names used for some of the Coccids in the list.

Pickett (A. D.), Patterson (N. A.), Stultz (H. T.) & Lord (F. T.). **The Influence of Spray Programs on the Fauna of Apple Orchards in Nova Scotia: I. An Appraisal of the Problem and a Method of Approach.**—*Sci. Agric.* **26** no. 11 pp. 590–600, 11 refs. Ottawa, 1946.

The author gives a short account of the development of spray programmes and changes in the Arthropod populations in apple orchards in Nova Scotia in

1908–1938, based on a paper already noticed [*R.A.E.*, A **27** 662], discusses current methods of approach to the problem of insect control and describes a series of long-term experiments that were begun in Nova Scotia to observe the effect of various spray chemicals on injurious and beneficial insects in orchards there. Both neglected and commercial orchards are treated with individual spray chemicals as far as practicable, and numerical records of as many species as possible are taken periodically and supplemented by general observation. Since fungicides must be used to control apple scab [*Venturia inaequalis*] in Nova Scotia and observations over a number of years indicated that those commonly used had a pronounced effect on the prevalence of certain insect pests, attention was largely devoted to them. To supplement the field studies, codling moths [*Cydia pomonella*, L.] and bud moths (*Spilonota ocellana*, Schiff.) were caged on small trees to oviposit, after which the cages were removed and periodical counts made of the eggs and larvae and of other insects present.

The detailed experimental results are to be the subject of subsequent papers, but brief descriptions are given of the experimental orchards and treatments, which consisted of a fungicide with or without an insecticide, usually lead arsenate, with notes on the more evident trends in Arthropod populations. Preliminary work indicated that modifications of the methods used will probably be required, and particularly that the size of the plots necessary varies with the mobility of the insect studied and its parasites. Distinct faunal differences were found in orchards treated with sprays of sulphur, copper compounds and Fermate (ferric dimethyl dithiocarbamate). In general, sulphur-treated areas had a much smaller number of species of Arthropods, but not necessarily a smaller number of individuals; this was particularly true of mites, since most species were practically eliminated by sulphur, but *Paratetranychus pilosus*, C. & F., sometimes became very numerous after the spraying season, as a result of the repression of natural enemies. Copper sprays resulted in a much larger number of species but fewer individuals, and Fermate probably caused more repression of the fauna than copper, but much less than sulphur. It is pointed out that since sulphur controls a large number of species, including beneficial ones, a change to copper or Fermate sprays may result in an increase of some species until their natural enemies become established.

DEAN (R. W.) & CHAPMAN (P. J.). **Biology and Control of the Apple Redbug.**— *Bull. N.Y. St. agric. Exp. Sta.* no. 716, 42 pp., 12 figs., 20 refs. Geneva, N.Y., 1946.

The following is based on the authors' abstract and summary. The apple red bug, *Lygidea mendax*, Reut., occurs in many apple orchards in the State of New York and sometimes causes extensive damage [*cf. R.A.E.*, A **36** 127]. The dark apple red bug, *Heterocordylus malinus*, Reut., is reported from western New York, but has been found only rarely in the Hudson Valley area and never in commercial orchards there. This bulletin is concerned exclusively with *L. mendax* and contains the results of investigations on its biology and control carried out from 1932 to 1945. Its feeding causes a reddish stippling of leaves on the terminals of branches, which is of no economic importance, and a gnarling and russeting of the fruit that may affect three-quarters of the crop in extreme cases. Observations on the McIntosh variety revealed no evidence that it caused excessive drop of small fruits.

The eggs are laid singly or in pairs in the bark and wood of twigs, small branches and suckers in summer and hatch in the following spring, beginning in late April or early May. The nymphs pass through five instars and reach the adult stage in early June. Both nymphs and adults feed on developing foliage and on fruits a quarter of an inch or more in diameter. The female begins to

oviposit about ten days after reaching the adult stage and continues until the middle of July or later.

The Mirid can be controlled by a petroleum-oil spray applied during the dormant or delayed dormant period or by a contact spray or dust applied at the calyx stage or within five days of the calyx period. The dormant oil spray should contain 4 per cent. of a paraffinic base oil and the delayed dormant spray 3 per cent. of a highly paraffinic product ; 2 oz. blood albumin per 100 U.S. gals. water or its equivalent in oil-depositing properties is advised as the emulsifier for the former [*cf.* **30** 95] and Bordeaux mixture (2 : 4 : 100) for the latter. Nicotine sulphate, used at 1 : 800 in the calyx spray is the standard treatment recommended against the nymphs. Dusts of nicotine sulphate and lime (2 per cent. nicotine) and dusts containing 0·15–0·2 per cent. pyrethrins gave excellent control when applied not more than five days after the calyx stage. The dusts were more affected by wind than the spray, and the nicotine dust was less effective at lower temperatures. No temperature effects were noticed in the case of pyrethrum dust, and temperatures as low as 55°F. did not decrease the effectiveness of the calyx spray of nicotine sulphate. Tar-oil emulsions and dinitro-o-cyclohexylphenol and sodium dinitro-o-cresylate in petroleum oil were ineffective against the eggs [*cf.* **21** 341 ; **22** 179 ; **32** 7], and aliphatic thiocyanates and a dicyclohexylamine salt of dinitro-o-cyclohexylphenol did not control the nymphs. Sprays containing rotenone gave fair control ; and calyx sprays containing 0·4 lb. actual DDT per 100 U.S. gals. and 5 per cent. DDT dust applied a few days after the calyx stage gave a high degree of control, but more information is needed before they can be recommended.

L. mendax has very few natural enemies. A parasite, supposedly Hymenopterous, was found to attack a small proportion of the eggs, a Hymenopterous larva was obtained from one fourth-instar nymph, and the capture of a fifth-instar bug by a small spider was witnessed. Other controlling factors apparently exist, but their nature is not known.

Papers noticed by Title only.

Insect Pests of Stored Nutmegs and Myrobalans [*Terminalia*]. [12 refs. 1919–43.] —*Sci. Lib. bibliogr. Ser.* no. 647, 1 p. multigraph. London, Science Museum, 1948.

Insect Pests of Stored Peanuts [ground-nuts]. [43 refs. 1915–47.]—*Sci. Lib. bibliogr. Ser.* no. 648, 3 pp. multigraph. London, Science Museum, 1948.

Insect Pests of Stored Roots of Derris and Cubé (*Lonchocarpus*). [15 refs. 1931–43.]—*Sci. Libr. bibliogr. Ser.* no. 649, 1 p. multigraph. London, Science Museum, 1948.

Cañadell Vidal (J. M.). **Experiencias y ensayos con un nuevo producto insecticida : el dicloro-fenil-tricloroetano (DDT).** [Tests of a new insecticidal Product : DDT (including some on its toxicity to rodents and birds).] —*Rev. ibér. Parasit.* **6** no. 4 pp. 309–342, 6 figs., 23 refs. Granada, 1946. (With a Summary in English.) [See *R.A.E.*, B **36** 138.]

Crisp (D. J.) & Thorpe (W. H.). **A metal Micro-respirometer of the Barcroft Type suitable for small Insects and other Animals.**—*J. exp. Biol.* **24** no. 3–4 pp. 304–309, 2 figs., 2 refs. London, 1947.

COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

LIBRARY LACUNAE.

The Institute will be greatly indebted to readers who may be able to supply any of the following, which should be sent to the Director, Commonwealth Institute of Entomology, 41, Queen's Gate, London, S.W.7.

Acta Brevia Sinensia (London) : No. 3 (1943).
Agricultural Chemicals (New York, N.Y.) : Vol. 1 (1946) Nos. 1–5.
Agricultural Journal, Department of Agriculture, British Columbia (Victoria) : Vol. 1 (1916) Nos. 1 and 2.
Agricultural News (Barbados) : Nos. 1, 25, 26, 34, 66 (1902–04).
Agriculture and Animal Husbandry in India (Delhi) : 1937–38 and 1938–39.
American Journal of Veterinary Research (Chicago, Ill.) : Vols. 1 & 2 (1940–41) Nos. 1–5.
Analele Institutului de Cercetări Agronomice al României (Bucarest) : Tome 14 (1942).
Anales de la Sociedad Científica Argentina (Buenos Aires) : Vols. 70 (1910) Nos. 2, 3, 4 ; 98 (1924) Nos. 5–6.
Annals of the Queensland Museum (Brisbane) : No. 5.
Archives de l'Institut Pasteur de Tunis (Tunis) : 1906–09 ; 1910 fasc. 1–3 ; 1911 fasc. 3–4.
Arquivos do Instituto Bacteriologico Camara Pestana (Lisbon) : Vols. 1–2 (1906–10) ; 3 (1911) No. 1.
The Bee World (Benson, Oxon) : Vols. 1–2 (1919–21).
Biological Bulletin of the Marine Biological Laboratory (Woods Hole, Mass.): Vols. 1–2 (1899–1901) ; 23 (1912) ; 24 (1912) No. 2 ; 25 (1913) Nos. 5–6 ; 26 (1914) Nos. 1–2 ; 27 (1914) No. 4 ; 28 (1915) No. 1 ; 29 (1915) No. 5 ; 30 (1916) Nos. 2–3 ; 31 (1916) Nos. 4 & 6 ; 32–33 (1917) ; 34 (1918) Nos. 1–4 & 6 ; 35 (1918) ; 36 (1919) Nos. 2–3 ; 37 (1919) Nos. 4 & 6 ; 38 (1920) Nos. 1, 2, 5 & 6 ; 39 (1920) Nos. 4–6 ; 40 (1921) Nos. 1–4 & 6 ; 41 (1921) Nos. 2 & 3 ; 42 (1922) Nos. 1–3.
Boletín de la Dirección de Estudios Biológicos (Mexico) : Tomos 1–2 (1924–25).
Boletín de la Oficina Sanitaria Panamericana (Washington, D.C.) : Vol. 22 (1943) No. 11.
Bollettino della Società Italiana di Biologia Sperimentale (Napoli) : Vols. 15 (1940) Nos. 5–12 ; 16–21 (1941–45).
Bulletin Agricole de l'Algérie-Tunisie-Maroc (Algiers) : Année 20 (1914) Nos. 7–9, 12–14.
Bulletin du Comité d'Etudes Historiques et Scientifiques de l'Afrique Occidentale Française (Paris) : Année 1919 No. 1.
Bulletin of the Stoneham Museum (Kitale) : Nos. 37, 41.
California Agricultural Experiment Station (Berkeley, Cal.) : Circulars 14 and 42 (1905–09).
Caribbean Forester (New Orleans, La.) : Vol. 1 (1940) No. 1.
Chacaras e Quintaes (São Paulo) : Indices to Vols. 10, 11, 12, 14 ; and 42 (1930) No. 3.
Choroby Roślin (Warsaw) : T.1 (1931) Cz.1.
Comptes Rendus des Séances de l'Académie d'Agriculture de France (Paris) : Tome 8 (1922) No. 5.
East African Agricultural Journal (Nairobi) : Vol. 5 (1940) No. 4.
East African Medical Journal (Nairobi) : Vol. 22 (1945) No. 7.
Egatea, Revista da Escola de Engenharia de Porto Alegre, Brazil (Porto Alegre) : Vols. 1–6 (1916–21) ; 7 (1922) Nos. 1–5 ; 8 (1923) Nos. 2–5 ; 9 (1924) Nos. 1, 4–6.
Egypt. Ministry of Agriculture (Cairo) : Bulletins 158, 162, 170–172, 174, 204, 212, 215, 227 (1938), 228, 230, 232, 235.
Entomologische Litteraturblätter (Berlin) : 6 Jahrg. (1906) Nos. 2 & 10.
Experiment Station Record (Washington, D.C.) : Vols. 1–4 (1889–94).
Folia Myrmecologica et Termitologica (Bernau b. Berlin) : Vol. 1 (1927) No. 10 to end.
La Forêt Québecoise (Quebec) : Vol. 1 (1939) Nos. 1, 4, 6, 10 ; 2 (1940) Nos. 1, 3, 6.
Gambia : Medical and Sanitary Reports 1939–42.
Georgia State Board of Entomology (Atlanta, Ga.) : Bulletins 2, 6, 22 & 28 ; Circulars 1–3, 12, 15–18 & 20.
Hong Kong. Botanical and Forestry Department : Report for 1939.
India : Forest Research Institute (Dehra Dun) : Forest Bulletin (Old Series) ; Nos. 1–3.
India : Imperial Council of Agricultural Research (Delhi) : Annual Report for 1939–40

NOTICES.

Secretaries of Societies and Editors of Journals willing to exchange their publications with those of the Institute are requested to communicate with the Director. Authors of papers on economic entomology, whether published in entomological journals or not, are invited to send reprints to the Director for notice in the *Review*.

The Annual Subscription, *in advance*, to Volume 36 of the *Review*, Series A (Agricultural), is 40s. post free ; Series B (Medical and Veterinary), 20s. post free. Prices of Back Volumes on application.

Orders and Subscriptions should be sent to the Director, Commonwealth Institute of Entomology, 41, Queen's Gate, London, S.W.7, or through a bookseller.

CONTENTS.

PAGE

AFRICA, FRENCH WEST: A Cerambycid on Shade Trees in Senegal ... 250

AFRICA, FRENCH WEST: Injury to the Pods of Ground-nuts by Termites in Senegal 250

AUSTRALIA: Tests of Sprays against *Cydia pomonella* in Tasmania ... 245

AUSTRALIA: *Anuraphis persicae-niger* and its Control in New South Wales 247

AUSTRALIA: *Heliothis armigera* and Fruit-flies in New South Wales ... 248

AUSTRALIA: *Lyctus* spp. and their Control in Queensland Timbers ... 248

AUSTRALIA: DDT against *Biprorulus bibax* on *Citrus* in Queensland ... 248

AUSTRALIA: Protection of harvested Potatoes from *Gnorimoschema operculella* 249

AUSTRALIA, SOUTH: Sprays against *Cydia pomonella* and Mites... ... 246

BRITISH ISLES: *Leptinotarsa decemlineata* in Jersey in 1939–46... ... 259

BRITISH ISLES: The Development of a Helicopter Spraying Machine ... 260

BRITISH ISLES: The Bionomics and Control of *Cydia nigricana* on Peas 261

CANADA: Studies on a Parasite of *Harmologa fumiferana* 255

CANADA: The Influence of Sprays on the Fauna of Apple Orchards ... 270

CEYLON: The Nomenclature of the Shot-hole Borer of Tea 251

FIJI: A new Species of *Erythroneura* 266

FIJI: Miscellaneous Pests and their Control 266

HAWAII: The first Record of *Dacus ferrugineus dorsalis* 249

HAWAII: Protection of Wood against *Coptotermes* by Copper Naphthenate 249

HOLLAND: Locally grown and imported Pyrethrum Powders 270

HOLLAND: Seed Treatment with DDT against *Hylemyia antiqua* ... 270

HUNGARY: The Spread of *Hyphantria cunea* 254

INDIA: Pests of Tea and *Eucalyptus* in 1945–46 250

ITALY: Tests with Thiocyanate Derivatives against Pests 252

ITALY: DDT against Flea-beetles on Flax 268

ITALY: The Bionomics and Control of *Leucoptera scitella* on Apple ... 269

NEW ZEALAND: Work on Pests and beneficial Insects in 1945–46 ... 244

POLAND: The first Record of *Leptinotarsa decemlineata* 254

POLAND: An Outbreak of *Neurotoma nemoralis* on Stone Fruits ... 254

POLAND: A new Species of *Megastigmus* injurious to Juniper Seeds ... 267

SOCIETY ISLANDS: A Lamiid on Fig in Tahiti 250

U.S.S.R.: The Parasites of *Eurygaster integriceps* in Tadzhikistan ... 241

U.S.S.R.: The Technique and Prospects of Biological Control 241

U.S.S.R.: A new Egg Parasite of *Bruchus pisorum* 242

U.S.A.: The Termination of Diapause in Eggs of *Malacosoma disstria* ... 243

U.S.A.: Methods of estimating the Area of Grape Foliage injured by *Erythroneura* 255

U.S.A.: DDT against *Cydia pomonella* on Apple 256, 257, 258

U.S.A.: Tests of the Effect of DDT on Insect Parasites 258

U.S.A.: The Biology and Control of *Lygidea mendax* in New York ... 271

Factors affecting the Fecundity of *Pyrausta nubilalis* 251

A Synopsis of the Genus *Tribolium* 261

The Development of *Ephestia elutella* on some natural Foods 264

A Host Index of Parasites of Aleurodids and Coccids 270

Bibliographies of Pests of certain Stored Products (*Titles only*) 272

Tests of the Toxicity of DDT to Vertebrates (*Title only*) 272

A Micro-respirometer suitable for small Insects (*Title only*) 272

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE
by the South Essex Recorders, Ltd., Ilford.

(967) Wt. P3/1804 9/48 S.E.R. Ltd. Gp. 432